FEBRUARY 1959

Power Engineering

ATOMICS

ALPR – A Small Nuclear Power Plant 43
ALPR Provides Power and Heat 44
Disposal of Radioactive Wastes 49
New Nuclear Literature 50

Aluminum Limited's Underground Hydro 68
Turbine Drives Add Steam Economy 70
Power Engineers' Valve Manual – Section VII 71
State Line Improves on Ash Handling 75
Silicon Rectifiers In Switchgear Control 77
How Big A Boiler Feed Pump Motor? 79
All Out For Complete Safety 84
Pasco Packing Co.'s Power Study 86
Staley Saves Water – Cuts Process Waste 88
ASME Annual Meeting Report 91
1958 New York Power Show 92

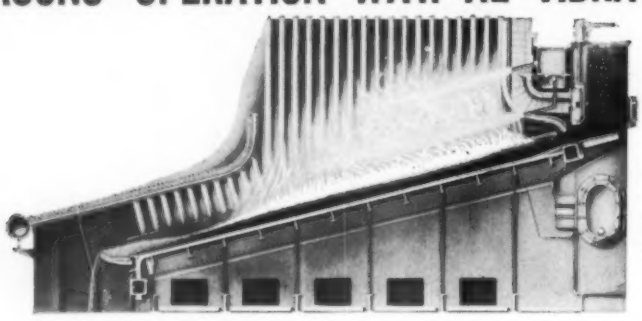
REGULAR DEPARTMENTS

Engineers' Preview 3
What They Tell Us 6
Helpful Bulletins 25
TRACERS 67
News Reel 82
Construction News 93
Power Engineering Handbook 94
Equipment News 108
Reader Service Post Cards 124
Catalog Library 124
Advertisers Index 128
Circulation of This Issue 42,751

REPORT FROM THE HOME OF JOHNSON'S WAX ON

Sketch of the Johnson's Wax administration and research center.

3 FULL SEASONS' OPERATION WITH AE VIBRA-GRATE STOKER



Side elevation of a typical Vibra-Grate Stoker installation

Mr. Adrian R. Wilson, Assistant Power Plant Manager, says this about the AE Vibra-Grate Stoker now in its 4th year of operation at the Racine, Wis., plant of S. C. Johnson & Son, Inc.:

★ **Never an unscheduled shutdown during 10 months' continuous operation in each of 3 years.**

★ **Cost of repair parts approximately one cent per ton of coal burned . . . total cost slightly less than $200 while burning 20,169 tons.**

★ **Evaporation rate of 11.3# of steam to 1# of coal . . . 19% improvement over figures before installation of Vibra-Grate.**

★ **Continuous operation at 150 psi . . . load swings of 15,000 - 20,000# with only 3# to 4# variation in pressure.**

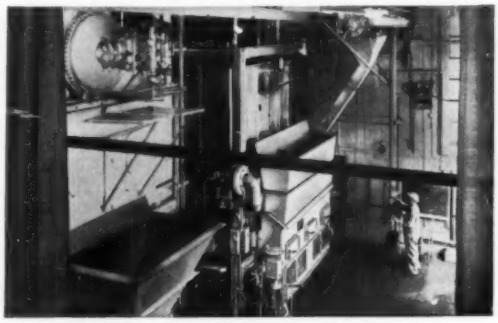
★ **Smoke and fly ash eliminated almost entirely, even in load range of 5,000 - 40,000# per hour. No fly ash collector needed. Since our plant is located in a residential area, elimination of these nuisances is extremely important from the public relations standpoint.**

★ **No trouble with clinkering or coking coals . . . they burn out to not more than 3% combustible.**

★ **A great variety of types and grades of fuel used without difficulty; low grade coals, wet bark mixed with coal, wood, sawdust, shavings, etc.**

The AE Vibra-Grate Stoker is designed to produce steam at the lowest possible cost per pound. Feeding and moving the fuel automatically by intermittent vibrating motions, the Vibra-Grate insures even distribution and avoids efficiency-reducing holes or light spots in the fuel bed. Its highly effective water-cooling system guarantees long grate life and minimum maintenance.

Years ahead of its time in design and performance, the Vibra-Grate offers you higher-than-ever efficiency at low over-all cost. If you're modernizing or replacing your power plant, write for details of the AE Vibra-Grate Stoker . . . you'll find it pays.



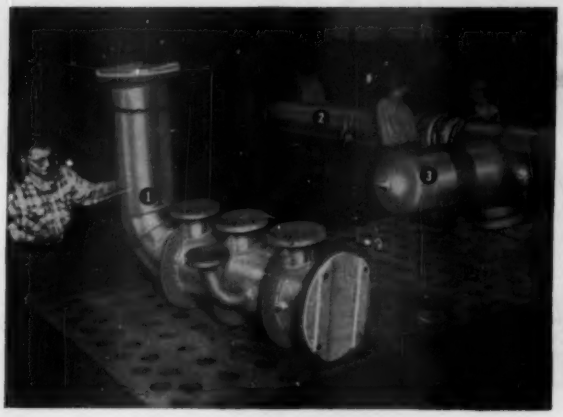
The Vibra-Grate as viewed from Mr. Wilson's office

AMERICAN ENGINEERING COMPANY
Wheatsheaf Lane and Sepviva Street
Philadelphia 37, Pennsylvania

Canadian Subsidiaries: Affiliated Engineering Corporations, Ltd., Montreal, P.Q., Bawden Industries Ltd., Toronto, Ont.

For more data circle 501 on Post Card

ALL IN A DAY'S WORK at *Pittsburgh Piping*



These three jobs are typical of the wide variety of custom piping work which we do for the power and process industries. In the background of the photo welders are shown making the heli-arc root pass on 18" O.D., 3.875" wall, chrome-moly main steam piping. In the foreground, ready for final inspection, is a 12" header for a process operation, fabricated of ⅜" aluminum alloy. The pressure vessel, of austenitic steel, is one of many we produce for atomic energy application. The manufacturing of this type of piping requires specialized facilities . . . for engineering, fabricating, testing, assembly, and erection. We have those facilities. Use them on your piping jobs.

Promoting Progress **IN POWER AND PROCESS PIPING**

Pittsburgh Piping **AND EQUIPMENT COMPANY**
158 49th Street—Pittsburgh, Pa.

Canada: **CANADIAN PITTSBURGH PIPING, LTD.,** 68 YONGE STREET-TORONTO, ONTARIO
Atlanta.....Whitehead Building
Chicago.....Peoples Gas Building
Cleveland.....Public Square Building
New Orleans.....P. O. Box 74
New York.....Woolworth Building

For more data circle 502 on Post Card

GRAVER REPORTS ON RESEARCH AND DEVELOPMENT

Here are the Latest Results

...of an intensive program of chemical research and engineering development carried on by Graver Water Conditioning Co. with a twofold purpose:

- to advance the art and science of liquid treatment
- to solve practical problems as they arise on individual jobs

Graver has made, and continues to make, studies of all aspects of equipment design, operating results and process techniques with the view to improving existing methods and developing new ones for the treatment of all types of liquids.

As new achievements are realized through this constant search, they are given practical form and made available for the benefit of the fields served by Graver: *power plant utilities, industrial and municipal water treatment, industrial waste treatment and chemical processing.* The products shown on this page are but a few of the recent developments from Graver's expanding facilities, now the largest in the liquid treatment industry.

OTHER GRAVER ACHIEVEMENTS

Iron and Copper Scavengers • Automation, Instrumentation and Control • Techniques for Prevention of Resin Fouling The Reactivator® • Spherical Ion Exchange Units Rota-Rake® Clarifiers and Thickeners Subfill-less Underdrain Designs • Shericone® Hot Process Sedimentation Units Increase of Ion Exchange Applications • Flotation Units Parabolic Plug Spray Valves • Sub-Surface Washers

Write for Detailed Literature, Dept. R

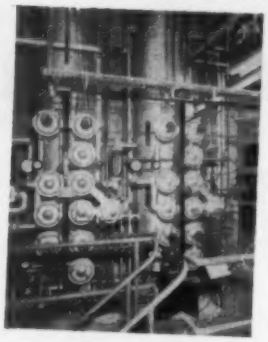
GRAVER

GRAVER WATER CONDITIONING CO.
Division of Union Tank Car Company
216 WEST 14th STREET, NEW YORK 11, N.Y.

IN CANADA: GRAVER WATER CONDITIONING CO.
Division of Products Tank Line of Canada, Ltd.
268 CHURCH STREET, MIMICO,
TORONTO 14, ONTARIO

For more data circle 503 on Post Card

GRAVER WATER CONDITIONING CO.
RESEARCH AND DEVELOPMENT SECTION



REPORT NO: 197

Condensate Scavengers-for power plant utilities. Equipment for internal self-purification of condensate in sub-critical as well as supercritical boiler cycles.

GRAVER WATER CONDITIONING CO.
RESEARCH AND DEVELOPMENT SECTION

REPORT NO: 204

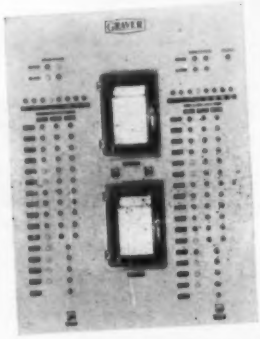
Dialysis Systems and Laboratory Units—for chemical processing and industrial waste treatment. Systems for separation of acid, alkali, neutral salt liquors.

GRAVER WATER CONDITIONING CO.
RESEARCH AND DEVELOPMENT SECTION

REPORT NO: 193

Non-Corrosive Underdrain — for municipal water treatment. New underdrain for gravity filters weighs much less than other designs and improves backwashing.

GRAVER WATER CONDITIONING CO.
RESEARCH AND DEVELOPMENT SECTION



REPORT NO: 187

Monitoring Systems — for all fields. Systems to check and report malfunction in the operation of demineralization plants, especially of the automatic type.

EDITORIAL AND BUSINESS STAFF

POWER ENGINEERING IS PUBLISHED MONTHLY
308 E. JAMES ST., BARRINGTON, ILL.
DUnkirk 1-1840
Chicago NEwcastle 1-0488

EDITORIAL AND ART STAFF

Editorial Director	Richard H. Morris
Editor	Chester R. Earle
Managing Editor	Robert F. McCaw
Associate Editor	Welden Reynolds
Associate Editor	Charles T. Maxwell, Jr.
Associate Editor	Jeff Hunnicutt
Equipment Editor	Marian E. Heniken
Editorial Assistant	Mildred Novosel
Art Director	James E. Wilcox
Staff Artist	Richard Trefilek
Artist-Draftsman	Ted Cieplay
Editor of ATOMICS	Andrew W. Kramer

OFFICERS AND BUSINESS STAFF

President	Kingsley L. Rice
Executive Vice President	Edwin C. Prouty
Treasurer	Arthur L. Rice, Jr.
Secretary	Edwin C. Prouty, Jr.
Production Director	John O. Aarvold
Production Manager	Earl R. Noren
Assistant Advertising Manager	Josephine Gear
Research Director	Eugene Zucker
Research Associate	Margaret Hoagland
Technical Assistant to President	Andrew W. Kramer

DISTRICT MANAGERS

Chicago 3, Ill. 110 S. Dearborn St.	Warren F. Saas DEarborn 2-5453
New York City & New England 842 Graybar Bldg. New York 17, N. Y.	William H. Relyea, Jr. LEXington 2-0308
Philadelphia, Pa., and New Jersey 15 Sunrise Drive Morris Plains, N. J.	Joseph E. Halloran JEfferson 8-7873
Pittsburgh 19, Pa. 404 Frick Bldg.	Robert R. Anderson COurt 1-4940
East North Central 2120 Shenandoah Road Toledo, Ohio	William B. Davis JEfferson 6-7947

WESTERN SALES MANAGER

John R. Morrison

McDonald-Thompson Offices:

Los Angeles 5, Calif. 3727 West Sixth Street	Connie J. Grabb DUnkirk 7-5391
Seattle 4, Wash. 1008 Western Ave.	Harry Abney MAin 3-3766
San Francisco 5, Calif. 625 Market St.	Les Meek YUkon 6-0647
Denver 2, Colo. 222 Colo. National Bank Bldg.	Robert Heidersbach KEystone 4-4669
Houston 6, Texas Room 214, 3217 Montrose Blvd.	Frank Vickrey JAckson 9-6711
Tulsa, Okla. 2010 South Utica	Ted R. Trautman Riverside 3-1981

Change of Address: Send to POWER ENGINEERING. Circulation Division, Barrington, Illinois. Please supply your position title, company name, company address. Request must reach us by 15th of month to make the change effective with the following month's issue.

Subscription Information: Published monthly; price in U.S. and possessions $10 per year; in Canada $11 per year; other countries $12 per year; single copies $1.

Indexed in the Industrial Arts Index and the Engineering Index on file in public and many private libraries.

Microfilm edition: Request prices from University Microfilms Inc. Ann Arbor, Mich. All volumes since 1948

Copyright 1959 by Technical Publishing Co., Barrington, Illinois. Accepted as controlled circulation publication at Concord, New Hampshire

NBP BPA

PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ENGINEERS' PREVIEW

LOOKING CONFIDENTLY ahead, the electrical manufacturing industry expects to produce $21,000,000,000 worth of goods this year. This volume is almost as high as that reached in the peak years of 1956 and 1957, and tops the 1958 mark by 7 per cent. This optimistic prediction comes from the National Electrical Manufacturers Assn.

Shipments of generation, transmission and distribution equipment, always a bellwether of industrial conditions throughout the nation, are due for a slight rise. Manufacturers forecast a 2 per cent gain in dollar volume over 1958 when total sales in this category amounted to about $2,000,000,000. In 1957, the figure was $2,400,000,000.

While the industrial apparatus group suffered a setback in 1958 because of the curtailment of expenditures for new plant and equipment, it too sees good times ahead, and forecasts an increase in volume of 7 per cent this year. This gain would mean a total of $2,900,000,000 for 1959. Sales last year were $2,700,000,000, a drop of 13 per cent.

The wire and cable industry, which expects an 8 per cent gain in 1959 business over 1958, reported $1,300,000,000 in sales in 1958. Electrical manufacturing groups which fared best in 1958 were those producing illuminating equipment, signalling and communications equipment and electrical products used in the building equipment and supplies category such as wiring devices, conduit, fuses, molded case breakers.

OWNERSHIP of Jas. P. Marsh Corp and subsidiaries has been acquired by Colorado Oil & Gas Corp of Denver, Colo. Marsh was founded in 1865 and today makes indicating pressure gages, thermometers, heating specialties, refrigeration controls and valves. Marsh will continue to operate as in the past, retaining their identity personnel, sales representation and policies. W. C. Norman, president of Colorado Oil & Gas, becomes chairman of Marsh's board. A. D. Rose will serve as president. Vice president for engineering is Bernhard Willach.

RATIO of installed capacitor kilovars to peak-load kw increased from 0.38 at the end of 1957 to 0.40 at the end of 1958, according to W. G. Hart, manager of power capacitor sales for General Electric.

Although installed kilovars did not increase at the same high rate as in previous years, Hart says the increase indicates that more utilities are becoming aware of cost reduction opportunities afforded by capacitors, and that there is a general trend to push system power factors toward unity.

He points out that 1958 saw capacitor prices reduced to an average of $4 to $6 per installed kilovar. Based on these prices, Hart says, capacitors will yield an investment return of approximately 30 per cent in terms of loss reduction alone.

ABOUT PEOPLE: Move-ups at Stone & Webster, Inc, place Whitney Stone, formerly president, as chairman of the board and chief executive officer. Richard N. Benjamin becomes president. Peter J. Rempe becomes president of Stone & Webster Service Corp.

Three new appointments in the Engineering Department of Consolidated Water Power & Paper Co include: James W. Taylor, named to head the newly-organized steam, combustion, and instrumentation section of the department; Norman Dietrich named to serve as Assistant Steam and Combustion Engineer; and George Davis as Assistant Engineer for Steam Distribution and Utilization.

Karl A. Gardner, chief engineer for Griscom-Russell Co, has been appointed as one of the two members from industry to serve on the executive committee of ASME's Heat Transfer Division.

Harold A. Mosher, assistant di-

rector of engineering for the Eastman Kodak Co, has been nominated for the office of president of the National Society of Professional Engineers.

Lauchlin M. Currie has been elected a vice president of the Babcock & Wilcox Co and placed in charge of the atomic energy division. To accept this new post, Currie retired as vice president of Union Carbide Nuclear Co.

AIEE has raised five members to the grade of Fellow, in recognition of outstanding contributions to the profession. These men are: Wallace L. Cassell, professor of electrical engineering at Iowa State College; Paul S. Colby, engineering consultant, Carolina Power & Light Co; Delmar L. Brown, superintendent of the testing department, Portland General Electric Co; Harold S. Endicott, dielectric measurements engineer, General Electric Co; and Henry F. Rempt, division engineer in charge of electronics and armament systems, Lockheed Aircraft Corp.

D-C VS. A-C, when it comes to overhead transmission, is the subject of a study made by A. J. Wood, S. B. Crary and C. Concordia of General Electric, and reported to the Winter General Meeting of AIEE. The study indicates that d-c overhead transmission will not be used economically "to any extent" in the U. S.

The capabilities and economics of a d-c overhead power transmission system are such that it is suited for the long distance transmission of large blocks of power. But for the estimated investment costs which might be realized after a period of development in the U. S., the G-E experts state, a minimum of approximately 350 miles is required to overcome the economic advantage of a-c.

Advantages of d-c transmission are listed as lower line costs, flexibility of an asynchronous tie and the high circuit loadings possible. A-c advantages are the probable lower terminal equipment costs, inherent flexibility and proved reliability of a-c systems and equipment.

Studying the economics of conductor sizes for d-c overhead transmission, the engineers report that relatively large conductors would be required in order to insure a reasonable power transmission efficiency and line voltage drop.

SALE of eight heat reclaimers which together can recover enough heat to supply the domestic hot water needs for a city of 600,000 people for one day, is reported by Patterson-Kelley Co. The eight units will provide a total reclamation of 82,900,000 Btu of heat per hour from waste process fluids at Cannon Mills at Kannapolis, N. C. This is estimated to be equivalent to the reduction of 94,050 lb of steam at 100-lb pressure, or 2710 bhp.

The reclaimers will be constructed completely of stainless steel, will contain about 33 miles of tubing, providing 173,500 linear feet of heating surface. They will process 3000 gpm of waste hot water to heat an equal amount of fresh water through temperature rises ranging from 60 F to 130 F.

SPENDING of more than $2,500,000 in taxpayers' money for the purchase of three generators from Brown-Boveri of Switzerland by the Tennessee Valley Authority, has been severely criticized by officials of the company which quoted the lowest bid of American firms. Point of view of J. L. Singleton, group vice president of Allis-Chalmers, as expressed to TVA's board of directors:

"Most of the money which comes from government institutions, such as the TVA, is wrung out of American taxpayers, both corporate and individual, in the form of taxes. . . . Your purchasing of this large quantity of heavy electrical apparatus abroad is ignoring your responsibility to play fair by spending money our government collects in the same kind of an economy from which it gets it."

Allis-Chalmers' bid was $4,290,180; Brown-Boveri bid was $2,639,000. Second low bid from an American firm was Westinghouse's $4,495,300.

RECORD FUEL ECONOMY has been exhibited by the diesel-powered MV Thomas Nelson, converted Liberty Ship, during 92,000 miles of service since her recommissioning in 1956. One of four converted Liberties under an experimental modernization program established by the Maritime Commission to replace original steam-engine propulsion plants, the Nelson was turned over to U. S. Lines, after commissioning, for regular cargo-service duty.

A total of 6647 hours has been logged on the Nelson's main engines — twin 3125-hp diesels built by Baldwin-Lima-Hamilton Corp. Rate of fuel consumption has ranged from 16 to 47 per cent lower than that for the other three experimental conversions. Propulsion systems of the other vessels are steam turbine, gas turbine and free-piston.

Over-all plant efficiency of the Nelson is 30 per cent.

MEETINGS AHEAD: 9th annual Iron and Steel Conference, sponsored by the Pittsburgh Section of the Instrument Society of America, will be held in Pittsburgh, March 11–12.

11th Western Metal Exposition is scheduled for March 16–20 in the Pan-Pacific Auditorium, Los Angeles. American Society for Metals will hold its Western Metal Congress concurrently in the Ambassador Hotel.

1959 Corrosion Show will be held March 17–19 at the Sherman Hotel in Chicago. At the same time and place, the National Association of Corrosion Engineers will hold its 15th annual conference. Among exhibitors will be makers of high performance alloy materials, heat resisting non-metallics, all kinds of plastic materials and equipment, coatings and linings, instruments for measuring corrosion processes.

Textile Subcommittee of AIEE will hold its 1959 conference April 2–3 at the Heart of Atlanta Motel, Atlanta, Ga. Meeting is designed to bring before managers, engineers, technicians and master mechanics of the textile industry, information about application of new equipment and discussion of operational problems of existing equipment.

Rural Electric Generation and Transmission Cooperatives' 10th annual operating conference will be held April 6–9 at the Hilton Hotel in Albuquerque, N. M.

Investigation of Space is the theme of the 1959 National Telemetering Conference planned for May 25–27 at the Brown Palace and Cosmopolitan Hotel, in Denver, Colo. Sponsors are AIEE, American Rocket Society, Institute of Aeronautical Sciences and the Instrument Society of America.

SLUDGE *situation gets a clean-up*

STANODIESEL Oil M helps keep diesels clean and running smoothly at Princeton, Missouri

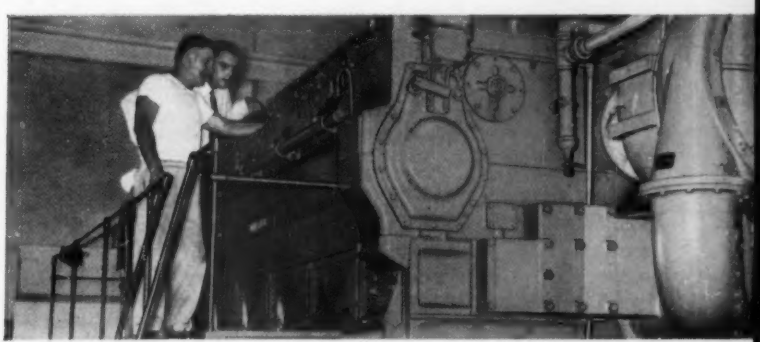
The situation: Consumer Public Service Company, Princeton, Missouri, has three diesels in service—a 225 hp unit installed in 1951, a 1,083 hp unit installed in 1954 and a 1,440 hp unit installed in 1956. In previous equipment, sludging had been a problem, so when these units went into service, a heavy duty oil was recommended—STANODIESEL Oil M.

What has happened: The oil has been inspected regularly by a Standard Oil lubrication specialist. Samples are periodically removed for analysis at Standard's Whiting Indiana research laboratory. Analysis shows the oil to be in excellent condition. Since the 1,440 hp unit was started up in 1956, it has generated 1,672,200 kw hours of electricity.

What you can do: Find out more about how STANODIESEL Oil M can deliver service in your plant. Ask for more information from the Standard Oil lubrication specialist near you in any of the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

Quick facts about STANODIESEL Oil M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by use of economy fuels.
- Maintains film on difficult-to-lubricate parts.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil mix.



Darrel McCormick, Standard Oil lubrication specialist and William Rutledge, plant superintendent, inspect 1,440 hp diesel in Princeton, Missouri plant. Darrel is an experienced hand at this work. He has an engineering degree from Vanderbilt University plus four years' experience in industrial lubrication work at Standard Oil. He has also completed the Standard Oil Sales Engineering School.

You expect more from **STANDARD** *and you get it!*

For more data circle 505 on Post Card

WHAT THEY TELL US

▶ **POSTING** lists of specific duties for each shift, as well as instructions on the care and maintenance of electric motors, did wonders to smooth out operation when the Wisconsin School for Boys in Waukesha opened a new power plant. These written-out instructions are framed under glass and hang at eye level on the operating floor of the plant. John M. Bass, chief engineer, says:

> Why did I take the time and effort to draw up such documents? The answer is simple: the men asked for it, since they had no experience with automatic controls and oil-firing equipment, at the time this plant was put into service. The men were at a loss to know just what procedure to follow, or what the man on the preceding shift had done. For example:
>
> The ball bearings on a pump or motor may have received lubrication three times a day instead of once each week; or perhaps the machine was not lubricated at all. This posed the problem, too, of who would take the responsibility for premature bearing failures, or for a motor burning up because of excess lubricants getting into the windings. And who would be responsible for steam blowing through the packing gland of a valve?
>
> Also, I have discovered that the handle of a mop or broom seems to hurt most men's hands, while the handle of a wrench does not. So who must do the menial tasks of keeping the plant clean?
>
> These are just a few of the problems that were solved by writing it all out plainly for all to see and read. Since we operate on a swing shift basis, an engineer going from one shift to another needs only to read the instructions for that shift to know at once what is expected of him.
>
> This simple bulletin board device has contributed immeasurably toward a smooth-running organization.

▶ **RECENTLY HOME** from a 4000-mile trip through the European portion of the USSR, Detroit Edison's president Walker Cisler says of the Russians:

> In electric power their thinking is remarkably like ours. Take atomic power, for example. The Soviets readily admit that right now it is too costly. They are investing heavily in atomic research and have built two atomic power plants, have planned more, but intend to use fossil fuels first. These they have in abundance. And it is the easiest way to produce steam.
>
> At present, their total capacity is about 48,300,000 kw. Ours in America is 150,000,000 kw. The contrast is startling when you realize they must cover an area two and a half times the size of the U. S. A., and their population totals 205,000,000 while ours is about 175,000,000. . . . The cost per kwh for a Soviet residential customer is about 4 cents, nearly twice our rate.

▶ **THIS IS THE POWER ENGINEER,** the new booklet published by us as a contribution in definition for the power engineering field, is reaching ever-widening circles. From London, Colin Troup, editorial director of the British periodical, *Steam Engineer*, writes in regard to it:

> I think this is a most useful publication, and I can imagine it was received with considerable interest in the States.

▶ **MOLASSES** expert in the house? E. H. Roper, chief mechanical engineer of Ohio Pipe Trades, Inc, writes us:

> What is the heat transfer rate through pipe coils filled with water, entering temperature 300 F, leaving temperature 180 F, with the coils submerged in molasses? We need to know its [molasses'] specific heat.

▶ **R. D. LANDON,** Dean of the College of Engineering of the University of Akron, Ohio, is among the thoughtful readers of K. R. Sturley's critical appraisal of American engineering education and training (last August, pages 95–96). Sturley is head of all training for the British Broadcasting Corp. Landon comments:

> I am in agreement with most of the author's observations and opinions, but I note one, it seems to me, rather major oversight.
>
> No mention was made of the coöperative method of engineering education, an American concept formulated by the late Dr. Herman Schneider at the University of Cincinnati over 50 years ago. In my opinion, any evaluation of engineering education in this country should contain an appraisal of the plan whereby students receive, during planned alternate periods, experience in industry.
>
> Mr. Sturley skirted the edge of such activity with mention of vacation experience in industry, but the coöperative plan accomplishes much more. It is providing industry with literally thousands of potential engineers who are being initiated at a time which is beneficial to both employer and employee. As many students must work to defray college expenses, it is certainly advantageous to all to formalize the work-study program, supervise it and make satisfactory work experience a requirement for graduation.

▶ **OUR OWN** interest in and feeling of concern for engineering education is certainly more than considerable, and we try to help the cause along wherever we can. In November, associate editor Jeff Hunnicutt went to the University of Wisconsin to participate in the Extension Division's Steam Plant Operation Institute. Hunnicutt lectured on Start-Up and Operation of the Medium to High Pressure Plant. Paul Grogan, chairman of the Division, writes:

> I want to thank you for the important part you played in making the program a success. Our comment sheets add to what I have to say in congratulating you upon the very fine manner in which you presented your material . . . I thank you . . . on behalf of the University of Wisconsin for your splendid and effective coöperation in our institute work.

▶ **SPECIALIZED** group to which many a reader may not yet have been introduced is the American Power Dispatchers Assn. A. E. Hill of the Association tells us that it was in 1945 that power dispatchers of electric utilities in the Northwest began to feel that they could form an organization which would be of benefit to themselves and management.

> Several test meetings were held in the various areas during the latter part of 1945. These meetings culminated in a meeting at Chehalis, Washington, in 1946, where the American Power Dispatchers Assn was born.
>
> The organization has had wholehearted backing of the utility companies for which the APDA members work. The Association has now grown to include system operators and dispatchers in New England, Pacific Northwest, Southwest, Wisconsin-Michigan area, Texas, a few other local areas, and in the Panama Canal Zone.

Why Every Steam Heated Unit Needs its Own Steam Trap

. . . the theory, practice and proof of "unit trapping" for top temperatures

Using an individual trap for each steam heated unit, including each separate coil, chest or chamber of a machine—pays off for the user. Here are just two examples:

1. On a creamery dryer

Drainage Method	*Air Temperature*
Restricted Blow-thru	250°
Group trapping (1 trap for 8 coils)	225°
Armstrong Unit Trapping (8 traps—1 for each coil)	**309°**

2. On a platen press

Drainage Method	*Processing Time*
Restricted Blow-thru	50 minutes
Group Trapping	35 minutes
Armstrong Unit Trapping	**25 minutes**

Why Unit Trapping Works Best

It is reasonable to assume that no two steam heated units will have *identical* condensing rates. Even the slightest difference in rate will cause a difference in steam pressure drops through the units. Here's where the trouble starts. Condensate from each unit may flow to the trap. But, what about air and other non-condensibles in the system? A difference in pressure drops too small to be indicated by an ordinary pressure gauge will permit backflow of steam from the higher pressure units to the lower pressure units. This backflow of steam may even impede flow of condensate from the lower pressure unit to the trap . . . and it will definitely impede or block off flow of air to the trap. The result is sluggish heating, reduced temperatures, reduced output, fuel waste and increased possibility of corrosion. Figures 1, 2 and 3 diagram the action.

Unit Trapping Not Costly

No engineer wants any more mechanical devices in his plant than are absolutely necessary. But, the moderate additional cost of using two or more small traps, instead of one big one, is saved over and over again in improved efficiency.

If the traps are Armstrong, maintenance is no problem. And users frequently tell us that Armstrong traps outlast others two and three to one.

Steam traps usually represent a fraction of 1% of the cost of the equipment they drain. Does it make good sense to lose 10% or more of equipment capacity to save a few dollars on traps?

Why not test Armstrong unit trapping in your plant. If you are not completely satisfied with the results you can return the traps for a full refund of the purchase price. There is little to lose—lots to gain. Call your local Armstrong Factory Representative or Distributor, or write **Armstrong Machine Works, 8102 Maple St., Three Rivers, Mich.**

ASK FOR the 44-page Steam Trap Book and reprint of article on Unit Trapping.

8015T

ARMSTRONG STEAM TRAPS

How Different Condensing Rates Can Slow Production

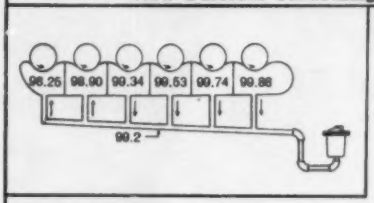


Fig. 1 This is a 6-roll ironer shortly after it has begun operating on 100 psi steam. When cold, wet material passes over chest 1, steam condensing rate is high and pressure drops accordingly. The pressure drop in chest 2 will not be as great, and so on down the machine as the material becomes progressively hotter and drier. Average pressure in the chests then is 99.27 lbs., and drain header pressure is slightly less, about 99.2 lbs. Under these conditions, steam from drain header enters chests 1 and 2 (as indicated by arrows at side of drain lines) because of pressure difference. Though condensate from chests drains by gravity, air can't leave chests countercurrent to incoming steam. Fig. 2 shows what happens next.

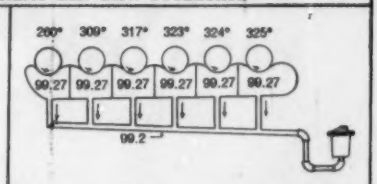


Fig. 2 This is the same 6-roll ironer after it has been operating a while. Air has accumulated in chests 1 and 2, reducing condensing rate and decreasing pressure drop. This process repeats itself down the line until pressures are as shown—that is, enough air will accumulate in each chest so that condensing rates and pressure drops of all chests will be about equal. The net result is shown in chest temperatures which are actual pyrometer readings taken on a 6-roll ironer, drained by a master trap, in a Chicago laundry. The laundry was making 337.9°F steam, but getting an average of only 309.6°F from the ironing surfaces, necessitating slow operation and frequent reruns. Then they tried Armstrong unit trapping—see Fig 3.

How Unit Trapping Prevents Trouble

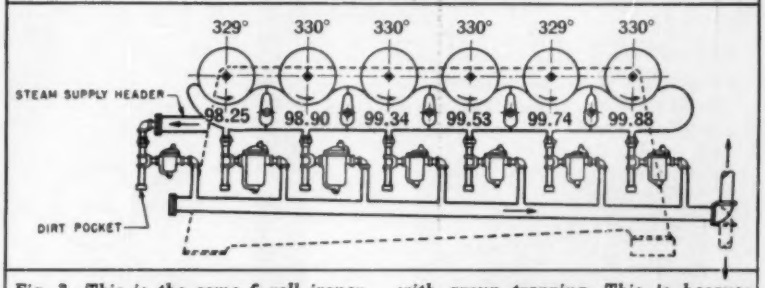


Fig. 3 This is the same 6-roll ironer, now unit trapped. Temperatures shown are also actual pyrometer readings—the average of 329.6°F is 20° higher than with group trapping. This is because air is continually removed from each chest into the drain header, and cannot get back into any chest.

For more data circle 504 on Post Card

What are your needs for

YARWAY COLOR-PORT WATER LEVEL GAGE

You get a *triple advantage* with the Yarway COLOR-PORT boiler water level gage for pressures to 3000 psi.

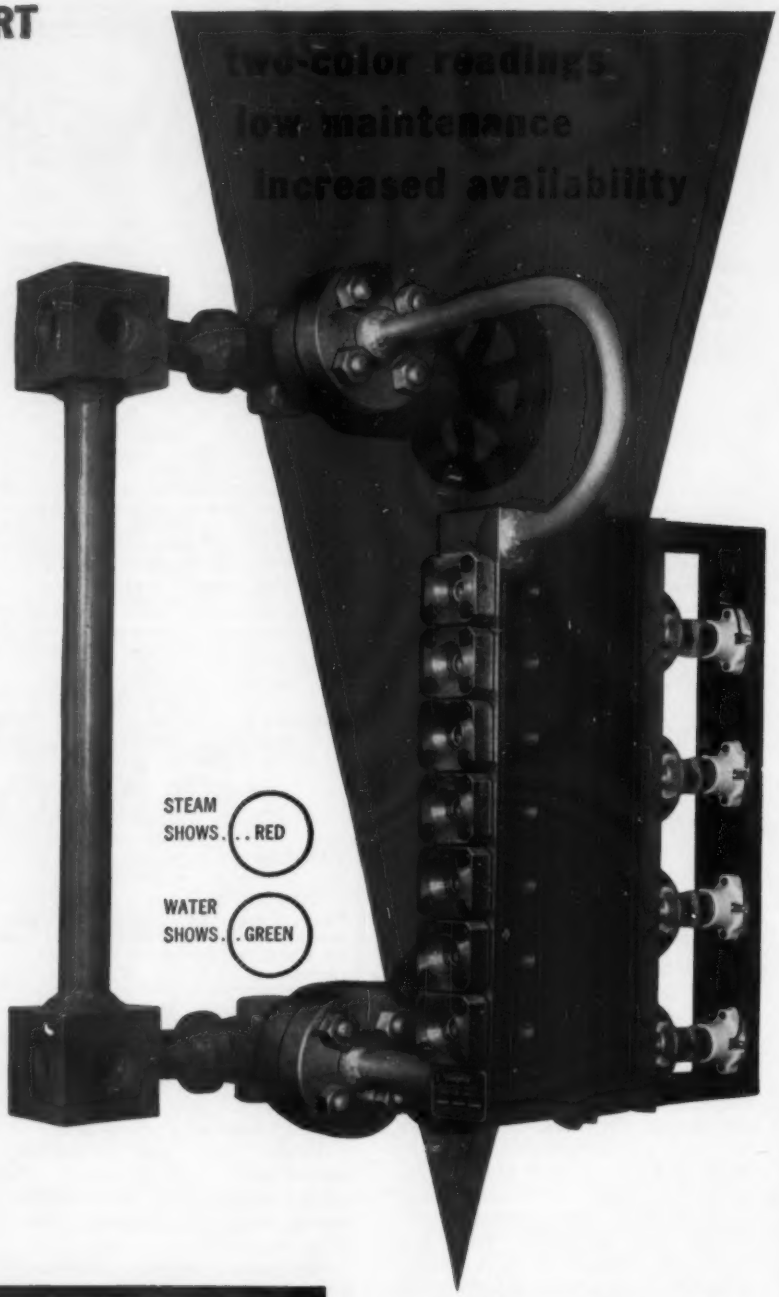
Two-color readings are brilliant and clear. Water shows green; steam shows red. A full gage is all green and an empty gage all red.

Low maintenance with individual cover-glass assemblies, each held solidly in place by four socket head cap screws. "Floating assembly" design applies safe, predetermined loads on glass ports, reducing thermal shocks, permitting faster warm-up.

Increased availability means longer service life. Cover glass assemblies can be *serviced in place*, easily and quickly.

Yarway Bulletin WG-1814 describes the Color-Port Gage. Write for it.

YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Pa.
Branch Offices in Principal Cities



YARWAY COLOR-PORT . . . *a good way to specify high pressure water gages*

boiler water level indication?

YARWAY REMOTE LIQUID LEVEL INDICATORS

Boiler water levels and other liquid levels requiring remote indication can be handled completely by a Yarway system.

Heart of the system is the Yarway Remote Liquid Level Indicator that gives instant, accurate readings because the mechanism is operated by the boiler water or other liquid itself. The pointer mechanism is never under pressure. Clear, "wide vision" face permits easy readings from any angle.

The Yarway Indicator conforms with A.S.M.E. Boiler Code Committee ruling (Case #1155) permitting two independent remote level indicators of compensated manometric type to replace one of two required gage glasses for boiler pressures 900 psi and above.

Electronic Secondary Indicators can be added at any point in the plant. Remote Hi-Lo Alarm Signals (lights and/or horns) can be connected for additional safety.

Primary indicators fully compensated for every pressure change in boiler also available.

For permanent record of changing levels, the Yarway Hi-Lo-Graph Recorder can be furnished.

Over 10,000 Yarway Remote Indicators have already been installed. For full details, write for Yarway Bulletin WG-1824.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

FULLY COMPENSATED INDICATORS

for completely accurate indication under every boiler operating condition

ELECTRONIC SECONDARY INDICATORS

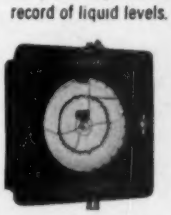
To supply additional indication at any point without pressure connections.

REMOTE SIGNALS

Hi Lo Alarms Lights and/or Horns.

RECORDERS

To provide permanent 24-hour record of liquid levels.

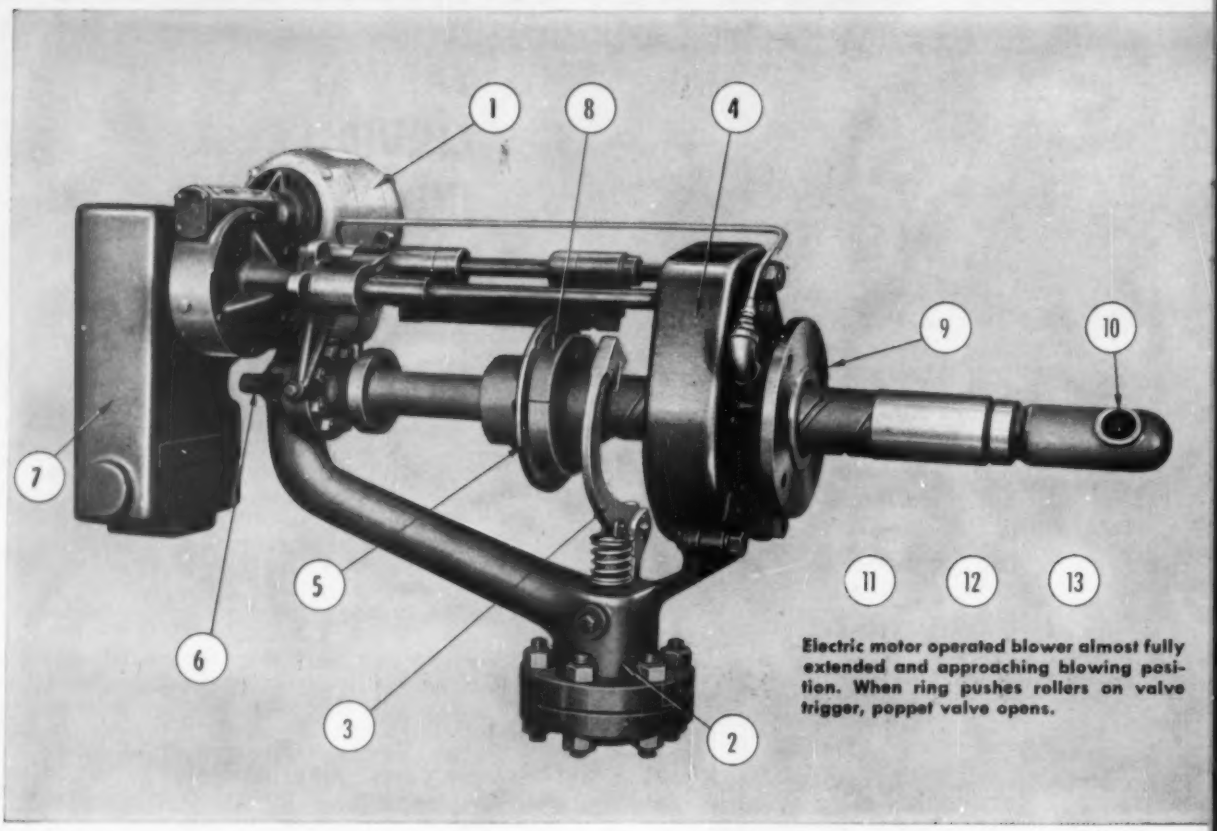


YARWAY

. . . a good way to specify remote liquid level indicators

For more data circle 506 on Post Card

For BETTER Boiler Cleaning



Electric motor operated blower almost fully extended and approaching blowing position. When ring pushes rollers on valve trigger, poppet valve opens.

(1) Single motor (electric or air) both rotates and propels the nozzle

(2) New high-flow poppet type valve assures tight seating without critical adjustment, has welded-in seat with stellited surfaces available.

(3) Positive mechanical action of valve without pilot or diaphragm actuation

(4) Positive mechanical drive through gears for all operations

(5) Valve can open only when nozzle is in blowing position

(6) Adjustable control for individual unit blowing pressure . . . no orifice required in line

(7) Simple, reliable control for local or remote push button operation . . . easily adapted to automatic sequential operation (either air or electric)

(8) Blowing arc easily adjusted for position and extent (up to and including 360°)

(9) Simple mounting on all types of wall construction. No other external support needed. Can mount in any position permitting piping drainage

(10) Improved blower nozzle provides more *available* cleaning energy per pound of steam or compressed air

(11) Completely automatic from start to finish

(12) Suitable for outdoor use without protection except under very severe ice conditions

(13) All operating parts readily accessible for easy maintenance

at LOWER COST

IMPROVED DIAMOND MODEL IR BLOWERS

(SHORT RETRACTING LANCE TYPE)

This improved Diamond Model IR Blower does a better job of cleaning water cooled furnace walls, hopper slopes or narrow portions of tube banks adjacent to walls. The retracting feature enables it to operate in zones of extremely high gas temperature; it will remove all dust and most slag deposits over a wide radius from the nozzle.

Cleaning furnace wall tubes effectively reduces gas temperatures leaving the furnace . . . improves overall efficiency of tube bank cleaning. Also, furnace wall cleaning contributes substantially to control of superheat and reheat steam temperatures on high-duty units.

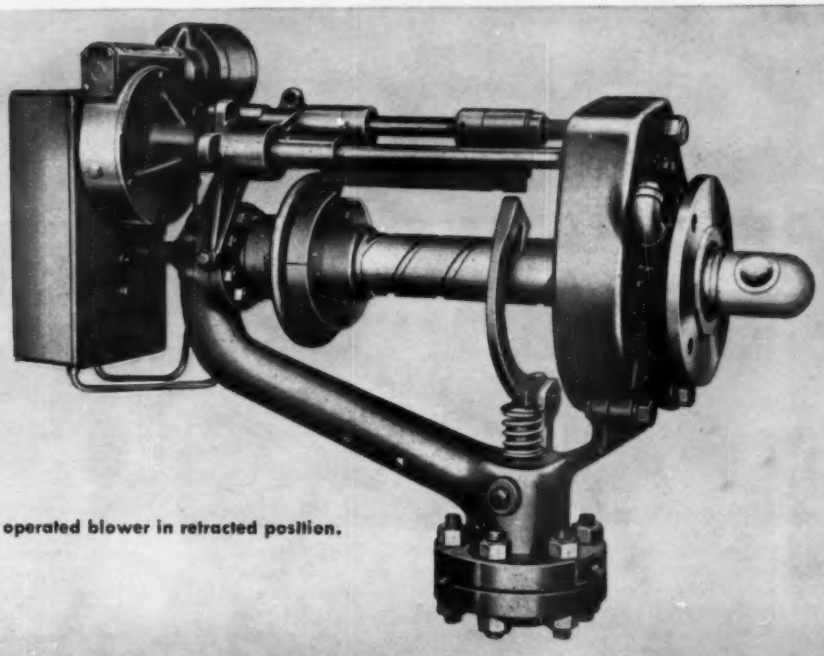
Check the features listed on the left-hand page. For additional information on the improved Model IR, ask your local Diamond office or write directly to Lancaster for a copy of Bulletin 1079AB.

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

Diamond Specialty Limited, Windsor, Ontario

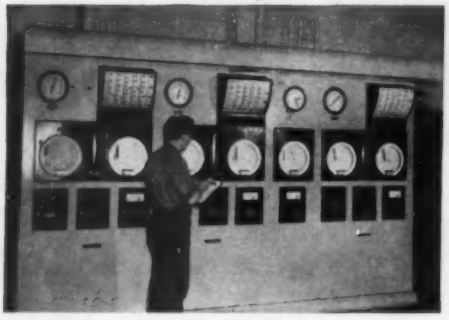
7949A



Air motor operated blower in retracted position.

For more data circle 507 on Post Card

Shown are two of the three Keeler boilers— fired by Detroit Spreader Stokers— in the power plant. At the right is the 22,000 lb/hr boiler. In the background is one of the 50,000 lb/hr boilers. The two sizes allow flexibility in operation for widely varying load requirements.



Control panel by Hays Corporation. This system regulates all operations of the boilers—steam pressure, draft, flue gas temperature, banking periods etc.—to give complete, automatic control of steam generating operation.

Ash disposal system, by United Conveyor Co., in basement of boiler room. Ash is removed from furnace by Detroit CC grate, and is taken by vacuum to silo.

Telephone manufacturer calls for coal

Automatic Electric Co. burns coal in new plant because of cost and availability

Modern facilities, modern products, modern fuel—you'll find all three at the new Northlake, Ill., plant of Automatic Electric Co., manufacturing subsidiary of General Telephone. The power house of this communications equipment plant (designed and built by The Austin Company of Cleveland) is as modern and efficient as the manufacturing process itself. The plant required large quantities of economically and reliably produced steam for process work and heating. The fuel selected was *coal*, because of coal's economy and abundant supply. As a result, today Automatic Electric enjoys dependable, low-cost steam.

Coal is lowest-cost fuel

Today, when the annual cost of fuel often equals the original cost of the boilers, you should know that bituminous coal is the lowest-cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% *more* steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

Technical advisory service

To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

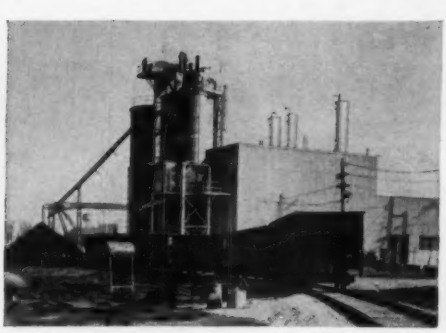
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

BITUMINOUS COAL INSTITUTE

Department PE-02, Southern Building, Washington 5, D. C.

See our listing in Sweet's



Exterior view of Automatic Electric power plant. Coal drops into track hoppers; then Stephens-Adamson conveyors move it up into coal silos. Silos have 5-carload capacity.

SEND COUPON FOR NEW "Guide Specifications for Underfeed Stoker Fired Low-Pressure Heating Plants." Heavy demand for the first edition of this booklet, adaptable for design loads 3,000 to 26,000 EDR steam, has justified an expanded edition covering application of underfeed stokers to firetube, watertube and sectional cast iron boilers. Complete specifications criteria cover all aspects of typical heating plant.

Bituminous Coal Institute, Southern Building, Washington 5, D. C. PE-02

Gentlemen: Please send me:

☐ Guide Specifications Booklet ☐ Case histories on larger plants
☐ I am interested in your advisory service

Name_____

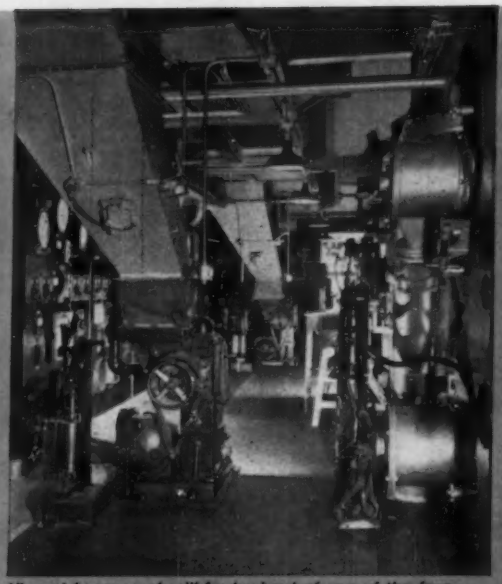
Title_____

Company_____

Address_____

City_____ Zone_____ State_____

For more data circle 508 on Post Card



View at burner and mill-feeder level of one of the four C-E Boilers which serves the Milwaukee plant

"The Beer That Made Milwaukee Famous"...

Eleven C-E boiler units, ranging from the semi-outdoor, oil-fired package type to the pulverized coal-fired, vertical unit type, provide the steam to make "The Beer That Made Milwaukee Famous."

Since 1946, when the Jos. Schlitz Brewing Company purchased four C-E boilers as part of an expansion and modernization program at Milwaukee, the Company has purchased C-E units for its breweries in Brooklyn, N. Y., Los Angeles, Calif., and Tampa, Fla.

Due to the nature of brewing and bottling operations, load swings are wide and rapid, and boiler response must be both unfailing and prompt. How well C-E boilers have met this challenge is evidenced by the repeat order record—a record made even more impressive by the fact that the Jos. Schlitz Brewing Company has obtained consistently high performance with not just one type of C-E boiler — but with three.

When you need a reliable and efficient source of steam — remember that the Schlitz slogan "Move Up to Quality" applies to boilers as well as beer.

Two oil-fired C-E boilers, Type VU-10, supply 60,000 lb. of steam per hr. for process purposes at the Schlitz brewery in Brooklyn, N. Y.

COMBUSTION

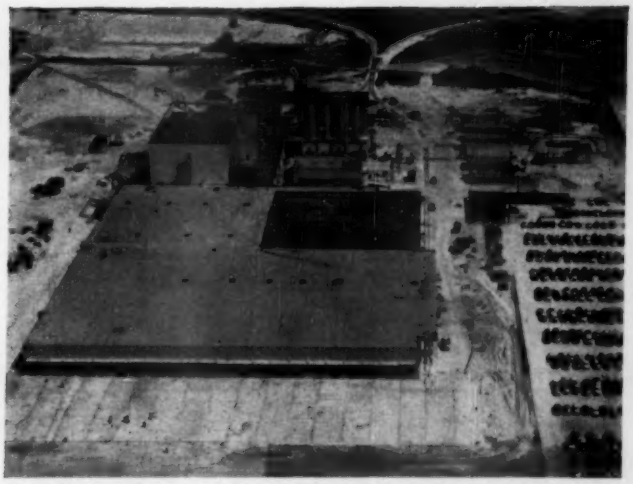
Combustion Engineering Building,

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

The Schlitz "headquarters" brewery at Milwaukee uses 4 pulverized coal-fired C-E boilers, Type VU, each with a capacity of 60,000 lb. per hr.

is brewed with C-E STEAM

This 20-million dollar showplace is the Schlitz brewery in Los Angeles, California, which uses 3 C-E boilers, Type VU-10. Fired with natural gas and oil, they generate 90,000 lb. of steam per hr.



At its Tampa, Florida, brewery, Schlitz uses 2 semi-outdoor C-E Package boilers, Type VP. They provide 72,000 lb. of steam per hr.

ENGINEERING

C-E

C-196

200 Madison Avenue, New York 16, N. Y.

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more data circle 509 on Post Card

A message of interest to users of Solenoids

DETROIT COIL COMPANY

Manufacturers of Power Solenoids and Solenoids

6428 MILTON ROAD
DETROIT 32, MICHIGAN
FERNDALE

Sept. 29, 1958

Bussmann Mfg. Division
McGraw-Edison Company
St. Louis 7, Mo.

Gentlemen:

In the development of any product, accelerated endurance tests are of the utmost importance. Since our test facilities run unattended for a considerable period of time, it was always an unknown factor when a breakdown occurred; and whether the breakdown was the result of an electrical or a mechanical cause. Since our introduction of Fusetron fuses to this test equipment, we have eliminated this unknown.

For this test work, we need a protective device permitting normal operation of the solenoid, but in the event of mechanical or electrical breakdown, stop the test at a stage where the cause for failure could be examined before the evidence was destroyed.

Approximately two years ago, we started using Fusetron fuses on these tests. We found them to have an amazing consistency in their rating. Since then, where the proper size Fusetron fuses were used, it has been possible for us to determine the direct cause of electrical breakdowns.

We believe that if Fusetron fuses of proper size were generally used in the field, a great deal of coil replacement could be avoided — and resultant costly shutdowns, required while a solenoid is being repaired or replaced, would be eliminated.

This would be a boon to our service department, too, as it would cut down the number of service calls we have to make where the problem is not directly due to failure of the solenoid.

We feel that general use of the Fusetron fuse protection for solenoids would help both our customers and ourselves.

The size Fusetron fuse we use on normal applications is generally about 125% of the holding current rating of the solenoid.

Yours very truly,

DETROIT COIL COMPANY

E. A. Viale

E. A. Viale
Vice President

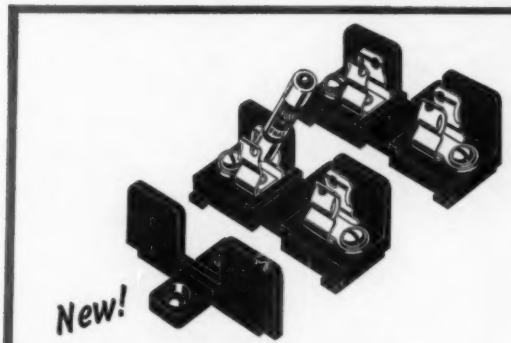
EAV:t

This amazing consistency is due to BUSS Engineering.

"A Great Deal of Coil Replacement could be avoided, and Resultant Costly Shutdowns Eliminated by Protecting Solenoids *with* FUSETRON FUSES."

E. A. Viale, VICE PRESIDENT
DETROIT COIL COMPANY

Protecting solenoids or other electrical equipment with FUSETRON Fuses—gives you greater safety, dependability and money-savings!



The BUSS Add-On Fuse Block for the protection of solenoids or Small Motors on Multi-Circuit Equipment

The BUSS Add-On fuse block makes it easy to protect equipment of any kind where a number of solenoids or motors are used.

Blocks are made up of single pole fuse blocks that interlock into a unit fuse block of any number of poles.

Poles may be added or removed . . . to either end of assembled fuse block. This makes it simple to have a fuse block of just the number of poles needed and to fit the block to available space.

Each fuse can be used as a circuit disconnect.

Specially designed fuse clips permit one end of fuse to be removed from clip and fuse raised to right angle to block where it is held firmly in position — see picture above.

When working on machine this makes it quick to identify circuit that is open — and it assures that proper fuse will be put back in right circuit.

Write for BUSS Bulletin BL-1.

BUSS and FUSETRON fuses are available to fit these fuse blocks in ampere sizes up to 30 and for voltages up to 250. Write for BUSS Bulletin SFB.

FUSETRON dual-element fuses provide 10 point protection against electrical troubles—unlike circuit breakers or ordinary fuses which, except in rare cases, protect only against short-circuits.

Fusetron Fuses remain safe — with no maintenance or recalibration required. They are calibrated at the factory by engineers. Once properly installed, they require no inspection and resulting downtime necessary on mechanically operated devices. There are no hinges, pivots or contacts to stick or get out of order. Dust, corrosion or oxidation cannot increase a Fusetron fuse's capacity or lengthen its blowing time.

After years of inactivity, a Fusetron fuse will give the same safe, dependable protection if called upon to open as it would have on the day it was installed.

For more information, write for . . . Bulletin FIS on Fusetron Fuses.

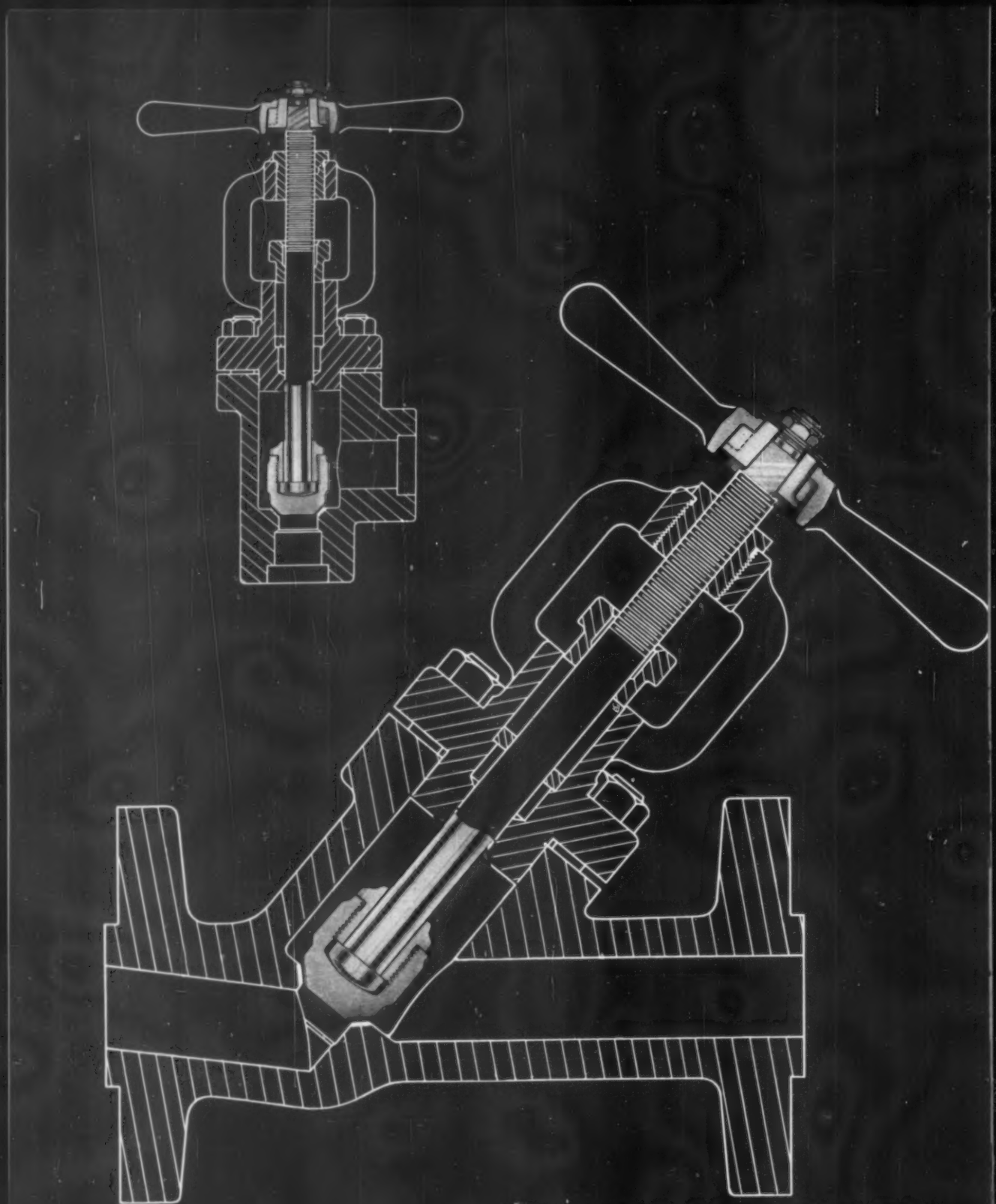
Bussmann Mfg. Division, *McGraw-Edison Co., St. Louis 7, Mo.*

159

Play Safe! Install Fusetron dual-element fuses throughout entire Electrical System.

FUSETRON BUSS — TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION — McGRAW EDISON — BUSSMANN MFG. DIVISION · St. Louis 7, Mo.

For more data circle 510 on Post Card



EDWARD FORGED STEEL BLOW-OFF VALVES

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

Edward Drop Forged Blow-off Valves

. . . the first—and still the newest!

Fifty years ago, when boilers operated at 250 lb sp the first really efficient means of blowing-down was with "new" Edward blow-off valves. Today, with pressure in the 1800-2600 lb range and with water temperatures sometimes exceeding 600 F, corresponding improvements in Edward blow-off valves have been effected. For example, today all Edward blow-off valves have integral Stellite seats and Impactor* easy closing handles.

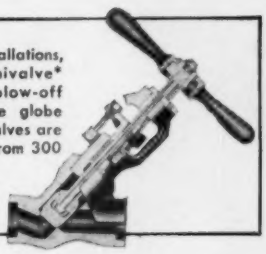
All over the world, high temperature-pressure steam power stations rely on these Rockwell-built Edward blow-off valves. The reasons are basic. Edward valves are simple and rugged in design, with no "trick construction." They operate easily, stay tight, need very little maintenance. If parts replacement is ever necessary, repairs are easier and less expensive than with any comparable valve.

The ASME Power Boiler Code requires steel valves wherever boiler drum pressure is above 200 psi . . . but, because blow-off service is severe at any pressure, operators of lower-pressure plants also have found it most economical to standardize on Edward valves.

Catalog 12-D2 tells the full story.

Recommended practice: Open valve nearer boiler first. Then slowly open other valve. After blow-off, close second valve first; then valve nearer boiler. This places greatest wear on blowing valve, assures a tight valve next to boiler, facilitates repair without a boiler shut-down.

Popular for high pressure installations, the Edward welded-bonnet Univalve* meets Code requirements for blow-off service and is ideal all-purpose globe valve as well. Edward blow-off valves are available in all pressure classes from 300 lb to 2500 lb in angle or straight-way styles, with flanged or welding ends.



Premium Features of Edward Blow-off Valves

- INTEGRAL SEAT of chromium-cobalt-tungsten alloy. Applied directly to body in a continuous ring, then machined in same set-up with bonnet guide bore for perfect alignment. Highly resistant to abrasion and corrosion.
- HARD-FACED DISK—Stellited for maximum resistance to abrasion and corrosion. Edward swivel-disk construction allows stem to lift vertically away from seat. No grinding or galling.
- POSITIVE BACKSEAT isolates packing from the high temperature zone. Line-contact backseat seals EValpak* valve packing from line pressure, permits repacking under pressure.
- IMPACTOR HANDLE, an Edward exclusive, is standard equipment. Several times more effective than ordinary handles or handwheels in opening or closing valves.

EDWARD VALVES, INC.

1202 West 145th Street, East Chicago, Indiana

Subsidiary of

ROCKWELL MANUFACTURING COMPANY

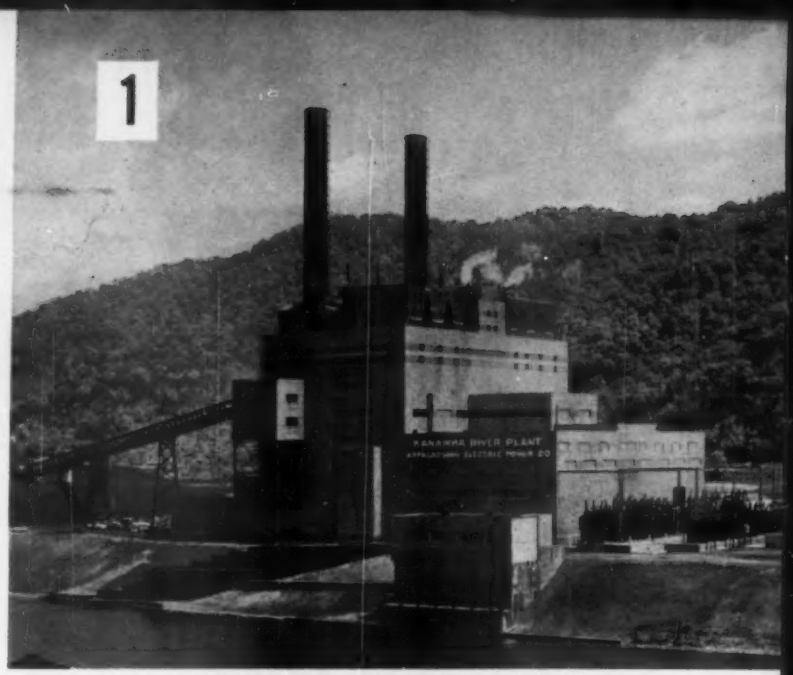
Represented in Canada by
LYTLE ENGINEERING SPECIALTIES, LTD., 360 Notre Dame St. W., Montreal 1, Que.

Edward builds a complete line of forged and cast steel valves from ⅛" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.

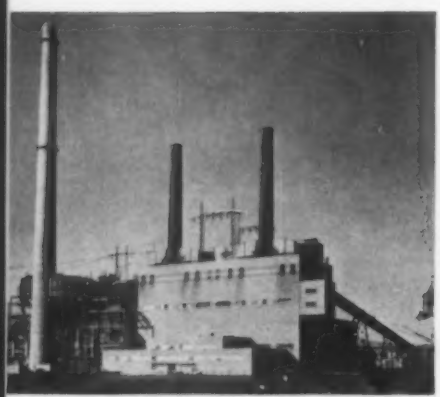
*T. M. Reg. U. S. Pat Off.

For more data circle 511 on Post Card

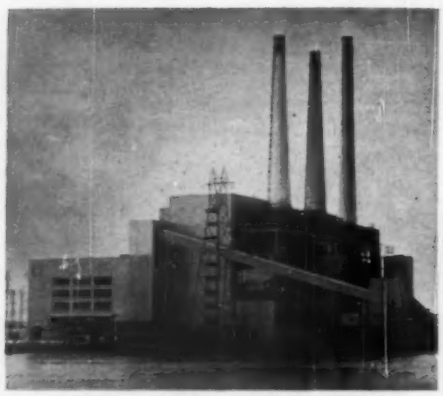
MOST EFFICIENT HEAT RATES IN THE POWER INDUSTRY



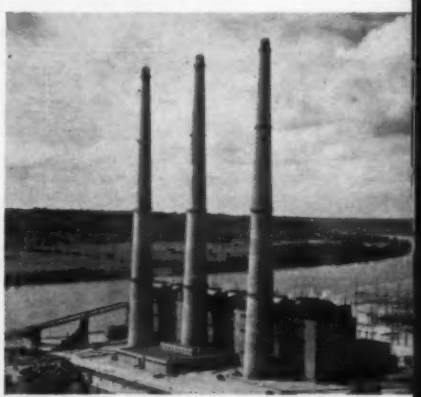
KANAWHA RIVER 9118 Btu/kwhr
Appalachian Power Co. on the American Electric Power System
Two B&W Pressure-Fired Radiant Boilers



MUSKINGUM RIVER
9139 Btu/kwhr Ohio Power Co.
on the American Electric Power System
Two B&W Pressure-Fired Open-Pass Boilers and one Pressure-Fired Radiant Boiler



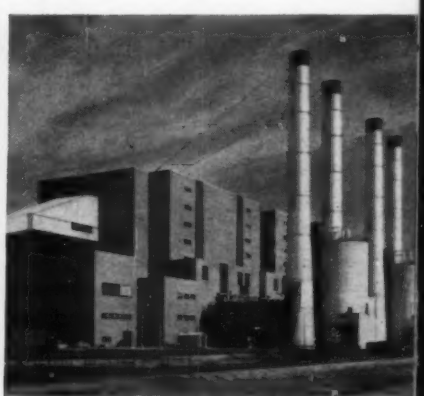
RIVER ROUGE 9140 Btu/kwhr
Detroit Edison Co.
One B&W Radiant Boiler
Firing 10% Blast Furnace Gas and 90% Coal



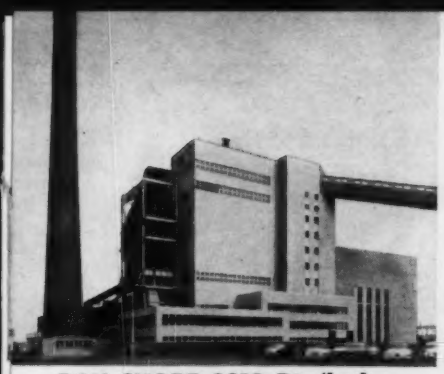
CLIFTY CREEK 9147 Btu/kwhr
Indiana-Kentucky Electric Corporation*
Six B&W Pressure-Fired Open-Pass Boilers

TANNERS CREEK 9180 Btu/kwhr
Indiana & Michigan Electric Co.
Power System on the American Electric
Three B&W Pressure-Fired Radiant Boilers

KYGER CREEK 9201 Btu/kwhr
Ohio Valley Electric Corporation*
Five B&W Pressure-Fired Open-Pass Boilers



ST. CLAIR 9210 Btu/kwhr
Detroit Edison Co.
Four B&W Radiant Boilers

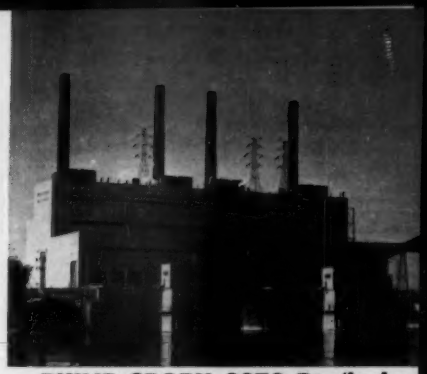


BAY SHORE 9210 Btu/kwhr
Toledo Edison Co.
One B&W Radiant Boiler

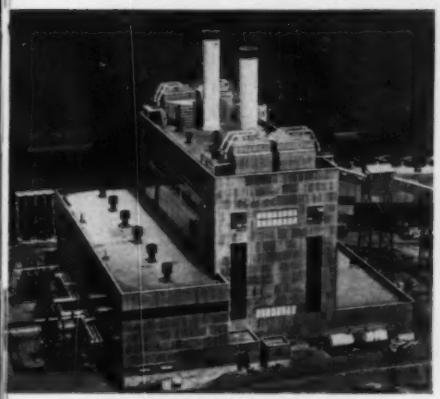
ALLEN 9349 Btu/kwhr
Duke Power Co.

JOHN SEVIER 9350 Btu/kwhr
Tennessee Valley Authority

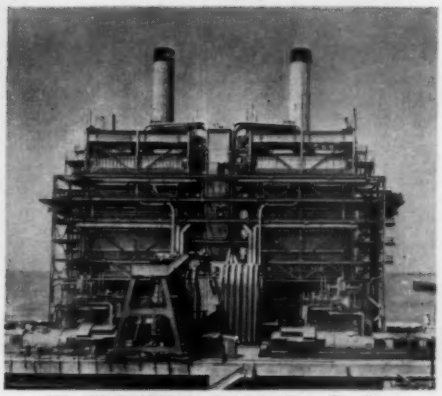
MILLIKEN 9371 Btu/kwhr
New York State Electric & Gas Corporation



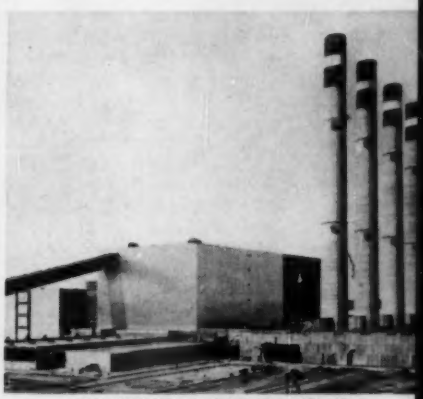
PHILIP SPORN 9370 Btu/kwhr
Appalachian Power Co. and Ohio Power Co.
on the American Electric Power System
Four B&W Pressure-Fired Radiant Boilers



SHAWVILLE 9396 Btu/kwhr
Pennsylvania Electric Co.
Two B&W Radiant Boilers



EL SEGUNDO 9467 Btu/kwhr
Southern California Edison Co.
One B&W Radiant Boiler



COLBERT 9470 Btu/kwhr
Tennessee Valley Authority
Four B&W Radiant Boilers

B&W Boilers Help Put 12 Power Plants Among Top 15 Most Efficient in Nation . . .

Outstanding proof that B&W engineering developments lead the way to reliable, economical power production

Of the 15 most efficient power plants in the United States as reported by the Federal Power Commission, 12 have B&W Boilers. Why? Because B&W's major investment in engineering research and development has led to great strides in power plant efficiency.

B&W is working with the Power Industry to keep electricity America's best bargain despite rising fuel and operating costs. Right now, B&W is investing millions of dollars in improved products—such as the Universal Pressure Boiler—in the better utilization of low grade fuels, basic metallurgical research for higher temperatures. In this way, B&W is helping America's utilities meet increased demands for abundant, economical electricity.

The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

G-901-C5

***Ohio Valley Electric Corporation and its subsidiary, Indiana-Kentucky Electric Corporation, sponsored by these companies:**

Appalachian Power Company[a] • The Cincinnati Gas & Electric Company Columbus and Southern Ohio Electric Company • The Dayton Power and Light Company • Indiana & Michigan Electric Company[a] • Kentucky Utilities Company • Louisville Gas and Electric Company • Monongahela Power Company[b] Ohio Edison Company • Ohio Power Company[a] • Pennsylvania Power Company[c] • The Potomac Edison Company[b] • Southern Indiana Gas and Electric Company • The Toledo Edison Company • West Penn Power Company[b]

[a]Subsidiary of American Electric Power Co. [b]Subsidiary of The West Penn Electric Co. [c]Subsidiary of Ohio Edison Co.

BABCOCK & WILCOX

BOILER DIVISION

For more data circle 512 on Post Card

Simplicity in steam traps can effect big savings in parts inventory and maintenance time

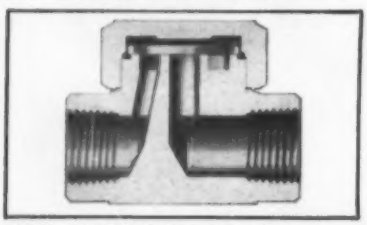
by John W. Ritter, Test Engineer
SARCO Company, Inc.

The function of all steam traps is to release condensate and prevent steam loss. However, the method of trapping can make a great difference in cost and effectiveness.

In the Sarco Thermo-Dynamic Steam Trap, the method is fundamental. Air or condensate entering the trap must flow from the inlet tube, radially across the underside of the disc valve, to the outlet. The space between the inlet tube and the disc forms a nozzle in which the static pressure energy of the incoming fluid is partly changed to velocity across the underside ot the disc, with a resultant *decrease* in pressure. (This will be recognized, of course, as the Bernoulli Principle.) Use of this fundamental method means reliability in operation.

As the high velocity fluid jet strikes the side of the upper chamber, some recompression takes place, so that the pressure above the disc becomes greater than the pressure below it. The pressure reduction under the disc and the pressure recovery above it depend on the internal energy of the fluid. As the condensate above nearly approaches steam temperature, its internal energy is enough to overcome the upward force at the inlet tube and the disc snaps down in the inlet tube, which is the inlet valve seat.

Simultaneously, the disc also seals the outer ring, which isolates the space above the disc from the outlet. The disc valve is therefore held firmly against the inlet valve seat until the pressure in the control chamber is reduced by condensation. The upward force then exceeds the downward force and the disc valve opens.



This 3-part Sarco TD Steam Trap has only one moving part—the hardened, polished stainless steel disc.

No other trap uses the velocity of the fluid to operate the valve or uses the recompression of the flowing fluid to trap the valve closed and to hold it closed. When it closes, it closes tightly – no "operating steam" leaks out.

40 seconds inspection time— that's all it takes for a SARCO TD Steam Trap

Just back off the cap of a Sarco TD. Lift out its single moving part, the stainless steel disc. Wipe it off, and drop it back. No adjustment is ever required, at any load or any pressure in its range – from 10 through 600 psi.

The TD operates in any position, won't blow steam at any load. Small as a tee fitting, it can be installed in tight places. Its versatility and reliability cut cost of big replacement inventory.

Write for "Literature Kit 2A" today and get latest bulletins on the TD Steam Trap and other Sarco steam traps. Remember that Sarco can give you impartial advice on *Production Planned steam trapping* because . . .

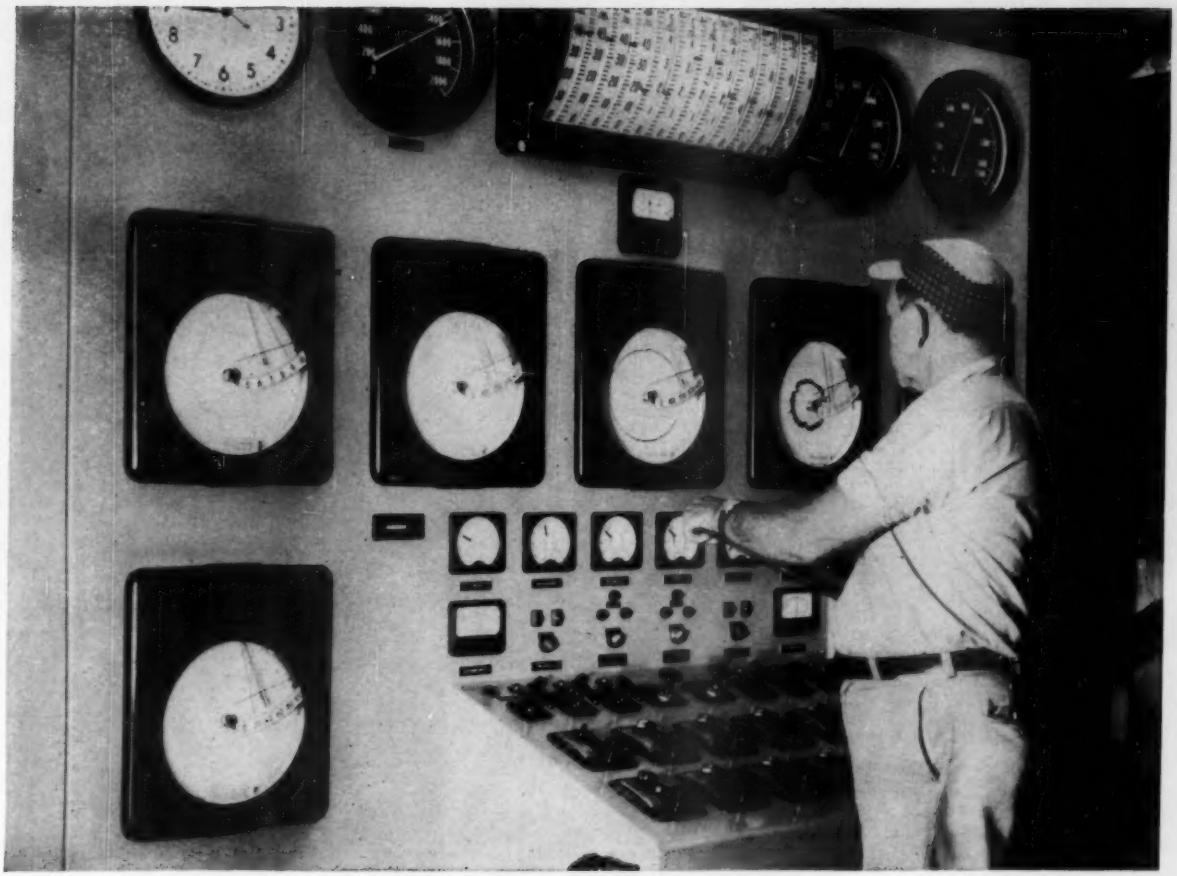
5605-B

SARCO
COMPANY, INC.
635 Madison Ave., New York 22, N. Y.

Only Sarco makes all 5 types:
Thermostatic • Liquid Expansion • Float Thermostatic
Thermo-Dynamic • Bucket

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

For more data circle 513 on Post Card



Control Room for Cyclone Furnace Boiler at Mathews No. 2 Power Plant of Greenwood Mills, Greenwood, S. C. Bailey MINI-LINE System concentrates controls at operator's station.

How BAILEY simplifies operation of STEAM PLANTS

Your operators can work more efficiently, make adjustments faster when you put Bailey Controls at their finger tips.

Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report.

Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs.

Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment, that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work efficiently for more than forty years. Veteran engineer and young engineer alike, the men who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant problems.

A138-1

Instruments and controls for power and process

BAILEY METER COMPANY

1040 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

For more data circle 514 on Post Card

BEACON COALS FOR ELECTRIC UTILITIES,

Industrial and Commercial Uses

Here are some facts that may interest you — as a buyer of coal for power plant use — when you are seeking a dependable source of supply.

Our yearly productive capacity is in excess of 10,000,000 tons. We can meet tonnage requirements of the largest user, and adhere to the strictest time-table on shipments.

We produce, in our fifteen active mines, a variety of coals with a complete range of analyses. We can thus satisfy the most exacting specifications . . . and furnish the fuel best suited to your particular combustion equipment.

We maintain a central coal laboratory, supplemented by quality control labs at each of our larger mines. This assures conformity to standards.

Our representatives are trained combustion men, who can understand your needs, and work intelligently to meet them. Inquiries and follow-ups are expedited by our teletype network, which connects sales offices with all our major mines.

Doesn't it seem reasonable to think that our *product* plus our *service* can bring you something extra in filling your fuel needs? We'd like to demonstrate that it can.

EASTERN GAS AND FUEL ASSOCIATES BEACON COAL

EASTERN GAS AND FUEL ASSOCIATES

Pittsburgh • Boston • Cleveland • Detroit • New York
Norfolk • Philadelphia • Syracuse

For New England: NEW ENGLAND COAL & COKE CO.

For Export: CASTNER, CURRAN & BULLITT, INC.

For more data circle 515 on Post Card

HELPFUL BULLETINS

Postage-free cards for ordering catalogs are on page 115. You may also use the cards to order literature mentioned in the ads.

ELECTRICAL

101 Aluminum in Electrical Systems — Electrical applications of aluminum are described in this 32-pp bulletin. The report discusses current economics of choosing aluminum for a broad spectrum of electrical applications. Topics include conduit, wire and cable, bus conductor, busway, armored cables, enclosures and switchgear, lighting fixtures and accessories, and such components as reactors, transformers. Aluminum Co. of America.

102 Short, Drip-Proof Motor — Bulletin 2150 describes the drip-proof Pancake motor featuring substantial reduction in motor length. Presents engineering information on this flange type motor. A cutaway drawing shows how it achieves short length through formed end coils and one-piece housing-bearing bracket. The Louis Allis Co.

103 Wet Winding Motors — Bulletin GEA-6883 describes submersible wet winding motors designed to run under water even with insulation and bearings immersed. The motors utilize irradiated polyethylene insulation and are rated 100 to 500 hp. Cutaway diagram, rating chart provided. General Electric Co.

104 A-C Generators — Sixteen-pp Form ACG958 is a product catalog describing construction, sizes, performance and other features of company's a-c generators. Features new line of brushless alternators for hazardous and other applications. Booklet also covers generator switchgear. Kato Engineering Co.

105 Power on Wheels — Versatile mobile substations in ratings through 10,000 kva, 69 kv and below, are described in Bulletin 61B9060. Equipped with transformer, high voltage switch, lightning arresters, fuses, low voltage switchgear, these substations are designed for emergency service, abnormal loads, etc. Bulletin discusses equipment, applications. Allis-Chalmers Mfg. Co.

106 Smaller Transformers — Advantages of Curvacore construction on company's three-phase transformers in ratings through 150 kva are described in 8-pp Bulletin 61B9049. The design is described as making possible reduced weights and heights, and affording faster installation and neater appearance as well as high thermal capacity and good regulation. Discusses construction details, lists accessories. Allis-Chalmers Mfg. Co.

107 Power Switches — Twelve-pp Bulletin PSEI on company's Type PV power switches, gives information on switches rated at 600 or 1200 amp and having voltage ratings from 7.5 to 69 kv. A new universal-mounting base, standard on these switches, is described in detail. Dimensional and mounting details are provided. Line Material Industries, McGraw-Edison Co.

108 Metal-Clad Switchgear — Bulletin 2804-1A, 24 pp, describes company's 4160-v metal-clad switchgear, covering indoor, and standard and walk-in outdoor type equipment with ratings through 3000 amp continuous current and 350-mva interrupting capacities. Bulletin is illustrated with photos, sketches, diagrams and drawings and includes charts and tables for detailed listings. Construction and performance features, ratings and dimensions are furnished. Panel layouts and dimensions for standardized units are provided, also a simplified ordering guide. I-T-E Circuit Breaker Co.

109 Enclosed Switches — Twenty-pp Catalog 83C, on industrial switches, gives details on nine housing groups of these metal enclosed switches, including explosion-proof, maintained-contact, prewired, hand-operated and sealed types. Booklet lists switches with a variety of actuator types to fulfill almost any requirement for general purpose enclosed switches. Micro Switch, Div., Minneapolis-Honeywell Regulator Co.

110 Rugged Limit Switches — Catalog 84, 16 pp, covering heavy duty limit switches, gives details of three types for industrial uses — a plug-in series featuring quick replaceability, a compact series, and rugged switches available in regular or explosion-proof types. Lists switches with a variety of contact arrangements, for d-c or a-c applications. Several actuator designs are shown. Micro Switch, Div., Minneapolis-Honeywell Regulator Co.

111 Anode Switchgear — Bulletin GEA-6841, 6 pp, gives information on function and application of company's Type AG-6 anode switchgear — a protective component of mercury arc rectifier equipment when continuity of service for large and/or essential d-c loads is necessary. Includes construction features, circuit diagrams. General Electric Co.

112 Tough Capacitors — Described in this 6-pp bulletin are El Menco Dur-Mica capacitors designed for long service. Includes data on small mica capacitors for extreme miniaturization, types for printed circuit wiring, others. Specifications include blueprint drawings of the various capacitors, with crimped or straight leads: capacity vs dimension tables; capacity and voltage range tables; temperature coefficient and capacitance drift limit charts. Electro Motive Mfg. Co.

113 Mercury Arc Rectifiers — Bulletin GEA-6848, 12 pp, covers operation, construction features and applications of company's pumpless mercury arc rectifiers from 750-kw, 250-v units for industrial service to units rated over 5000-kw, 850-v for electrochemical service. Includes cross-section line drawing of pumpless tank, photos, charts, system diagram and rating tables. General Electric Co.

HEATING, VENTILATING AND AIR CONDITIONING

114 Heating, Ventilating Units — Twenty-pp Bulletin 910 describes Herman Nelson heating and ventilating units, in 12 sizes with capacities from 600 to 73,000 cfm. Book gives information on coil selection for both steam and hot water. Capacity tables, air resistance charts and rpm and hp tables are provided. A section is devoted to dimensions and standard arrangements. Generously illustrated, bulletin describes components and accessories of the line, including the Roll-O-Vent automatic filter. American Air Filter Co., Inc.

115 Axial Flow Fans — Bulletin 5802 describes axial flow fans designed to provide high air displacement and pressure for cooling, heating and ventilating. Suggested applications are listed. Included is table of electric motor specifications for 27-v d-c 400- and 60-cycle a-c models. Pesco Products Div., Borg-Warner Corp.

116 Air Conditioner — Twelve-pp Bulletin 9327 outlines features of company's individual room design air conditioners, and describes various enclosures available. Cooling ratings are listed, as well as heating capacities, water pressure drop and one-row steam coil heating capacity. A series of installation-type drawings provide dimensional data, and line drawings illustrate possible arrangements. Specifications are also given. Industrial Div., American-Standard.

PUMPS, COMPRESSORS

117 Ceramic Pumps — Bulletin LV-758 describes company's LV series pumps available in heads to 180 ft and capacities to 600 gpm, maximum temperature 400 F. Discusses shaft, seal assembly, impeller, other components, and includes capacity data, application information. General Ceramics Corp.

118 Controlled Capacity Pumps — Catalog 100, 8 pp provides detailed description of company's Series 100 proportioning pumps. Also contains information on chemical feed pump-tank package system. Includes data on materials of construction, modifications. A quick selection chart covers simplex and duplex models. Pump Div., American Meter Co.

119 Controlled Volume Pumps — Bulletin 258 describes Milroyal controlled volume pumps with totally enclosed drives. Discusses design features of the pumps and tells how they work. Also gives specifications. These pumps are designed for metering of chemicals against pressures to 1900 psi in adverse atmospheres. Milton Roy Co.

120 Motor-Pump Units — Twenty-sizes of Motorpumps with off-the-shelf availability are featured in 8-pp Form 70022. They come in sizes of ¼ through 25 hp, for heads to 190 ft, capacities to 775 gpm. Bulletin contains drawings pinpointing features of the units' impellers, seals, casings and motors. Selection charts, friction tables and typical work sheet included. Ingersoll-Rand Co.

121 Unit Air Compressors — Twelve-pp Bulletin SG-2, illustrated in

color, describes G single-stage, YS single-stage and YC two-stage compressors from ½ to 15 hp, available pressures from 80 to 250 psi. Specifications list cfm displacements, pressures, weights, dimensions. Parts and accessories are discussed. A section is devoted to air receiver and auxiliary storage tank data. Le Roi Div., Westinghouse Air Brake Co.

BOILERS, AUXILIARIES

122 How to Select a Boiler — Filled with illustrations and graphs, this 20-pp pocket size booklet is a guide to boiler selection. Covers such topics as first cost vs operating costs, fuel selection, construction cost savings, low headroom solutions, packaged vs built-up boilers, design standards, boiler efficiency. Cleaver-Brooks Co.

123 Automatic Boiler — Guide Specifications GS-3, about 36 pp, presents typical applications of the Coal-Pak automatic boiler, covering use as low-pressure heating plant, low-temperature hot water plant, and high-pressure process plant. Illustrations include plan views, wiring diagrams for field connections, ash conveyor details. Bituminous Coal Institute.

124 Boiler Code Guide — This handy wall chart is a quick reference guide to ASME boiler and pressure vessel code. Its purpose is to illustrate some of the types of pressure vessel construction provided for under Section VIII of the ASME code and to furnish direct references to rules applying to these construction features. Missouri Boiler and Tank Co.

125 Spreader Stokers — Recently reissued, 12-pp Booklet 2530 gives detailed information on pneumatic spreader coal stokers which automatically meter, dry, preheat, convey and fire all sizes of coal and all grades from lignite to best bituminous. Cutaway views, installation photos and diagrams illustrate descriptive text. Iron Fireman Mfg. Co.

126 Fuel Burning System — Eight-pp Bulletin 1255 lists 11 sizes of oil, gas and combination gas and oil burners for firing boilers or other heat exchange equipment. Cutaway views in full color show operating principles. Typical burner arrangements and some installations are also pictured. Orr & Sembower, Inc.

INSTRUMENTS AND CONTROLS

127 Servo System Components — Electrohydraulic servo system components are introduced in four new publications. Bulletin 36100, 8 pp, on electrohydraulic servo valves, illustrates and describes construction and operating principle of this plunger-less valve design. Specifications, flow curves and installation dimensions are included. Bulletin 36200 covers specifications, capabilities and operation of company's universal type amplifier. Bulletin 36300 illustrates and describes construction and specifications of preset units. Bulletin 36400 presents many of the forms and types of amplifier and control panels for operating the systems. The Oilgear Co.

128 Temperature Controls — Form 1087, on pneumatic temperature controls, introduces Model RVA, a recording control, and Model IVA, an indicating control. Descriptive text stresses versatility, accuracy, other advantages of the instruments. Gives temperature ranges available, material specifications, information on accessories. The Partlow Corp.

129 Temperature Instrument — An electronic temperature-indicator monitor is described in Bulletin MSP-155. Gives operational features and specification data on the instrument and discusses switching, amplifying, off-normal alarms, power supply and basic parameters. Kybernetes Div., Hagan Chemicals & Controls, Inc.

130 Precision Gages — Catalog DH-65, 36 pp, presents the full line of Helicoid gages and features newly designed Safe-T-Case gages for severe or dangerous services — wherever a gage may be subjected to violent pressure pulsations or severe mechanical vibrations. Engineering information provided covers explanation of how the gages work, types of systems, adjustments, applications, specifications, and dimensions. Included is list of recommended uses. Helicoid Gage Div., American Chain & Cable Co., Inc.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 115 and 116.

131 Liquid Level Gages — Eight-pp Catalog 338 covers Truscale gages including standard, Red Flasher and inclined styles. Information on various styles, models and datum columns simplifies selection of gage for a specific requirement. Gives operation and application data and describes accessories. Jerguson Gage & Valve Co.

132 Well-Type Manometers — A redesigned and expanded line of well-type manometers for measuring pressure, vacuum, and differential pressure in plants and laboratories is described in 24-pp Catalog 2008. Features of design and construction are illustrated and detailed specifications given. King Engineering Corp.

133 For Difficult Fluids — Bulletin 19A presents metal tube Rotameters for measuring rate of flow of hazardous and high pressure fluids at temperatures to 400 F. Provides simplified instructions for sizing Rotameters for liquid service. Tables give dimensions, capacities. Sectional drawings explain operation. Schutte and Koerting Co.

134 Variable-Area Meters — Specification Bulletin 10A1485 gives capacity data on the Floguide, a metal tube variable-area meter with glass tube indicating extension, for use on pulsating liquid or gas flow applications, as in low pressure gas fluid measurement on gas-fired furnaces. Six-pp Specification Bulletin 10A1700 O/U covers the extension type Flowrator, a glass tube variable area meter designed to show flow rate. Fischer & Porter Co.

135 Control System Guide — To aid in designing and planning an automatic control system for most types of heating, ventilating and air conditioning installations, 8-pp Form F-8944 analyzes three important phases of planning. Part 1 discusses application, advantages and features of company's Electrionic control centers. Part 2 presents electric, electronic and Electrionic types of control. Part 3 deals with selecting power control system and covers factors to consider in air conditioning installations. Barber-Colman Co.

136 Burner Control Systems — Folder 5803-A describes pre-wired, panel control systems for automatic oil, gas or dual-fuel burners in industrial and commercial boiler installations. Included are dimensions, illustrations, selection chart for ready identification of panel assemblies. Iron Fireman Mfg. Co.

VALVES, PIPING, FITTINGS

137 Diaphragm Valves — Six-pp Bulletin 115 contains helpful suggestions that should be considered when selecting valves for process piping systems. Advantages of diaphragm valves and their ability to meet pipe specifications are also covered, and typical process applications are shown. Hills-McCanna Co.

138 Temperature Control Valve — Bulletin J-180 describes a sliding gate, self-operating temperature control valve for ventilating and process systems, heating and cooling. A cutaway showing components is included, as well as drawings of typical installations. Tables giving dimensions, weights, valve sizing charts are also provided. Jordan Industrial Sales Div., OPW Corp.

139 Pipe Suspension, Support — The values of pipe hangers and suspension equipment in the field of industrial construction are discussed in this 22-pp bulletin. Generously illustrated, it covers a variety of suspension products and includes detailed specifications. Fee & Mason Mfg. Co., Inc.

140 On Lightweight Pipe — Eight-pp Bulletin 59 is a condensed catalog on steel pipe, fittings, flanges and connections featuring strength and light weight. Data include standard specifications for Lock-seam Spiralweld pipe in 4- to 30-in. diam, information on one-piece Wedgelock couplings and other connections, and standard fittings and welding flanges. Ordering information and application suggestions in many industries are provided. Naylor Pipe Co.

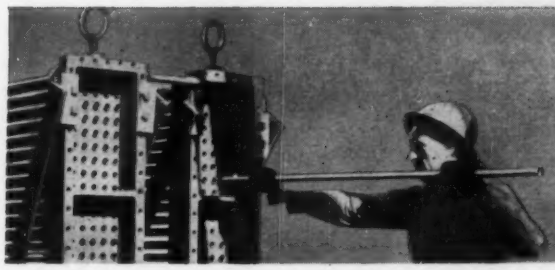
141 18-8 Tubular Products — Eight-pp Technical Data Folder TDC-190 covers 8-18 stainless steel tubing and pipe, fittings and flanges. Contains data on analyses, corrosion and oxidation resistance, high and low temperature characteristics, physical and mechanical properties of this family of stainless steel. Tubular Products Div., The Babcock & Wilcox Co.

142 Self-Cleaning Strainer — Bulletin 1210B describes a line of self-cleaning, semi-steel pipeline strainers in sizes from ¼ through 3 in., featuring high strength construction of the bodies, long, tapered screen socket, perforated heavy-gage screen. Includes dimensions, weights, prices. Sarco Co., Inc.

INSULATION

143 Insulating Cement — This bulletin gives information on Cominco insulating cement for high temperature insulation of boilers, ducts, headers, turbines, valves, piping, heat exchangers, etc. Provides data on various grades, methods of application, recommended thicknesses and thermal conductivity ratings. United States Mineral Wool Co.

144 Foam Insulation — Expanded polystyrene insulation for cold storage applications is featured in this illustrated bulletin. Method of application is shown



CONDENSER AND HEAT EXCHANGER CLINIC

Edited by David S. Hibbard, Metallurgical Engineer
The American Brass Company, Waterbury 20, Conn.

The trend is to longer, small-diameter heat exchangers in high-pressure, high-temperature systems

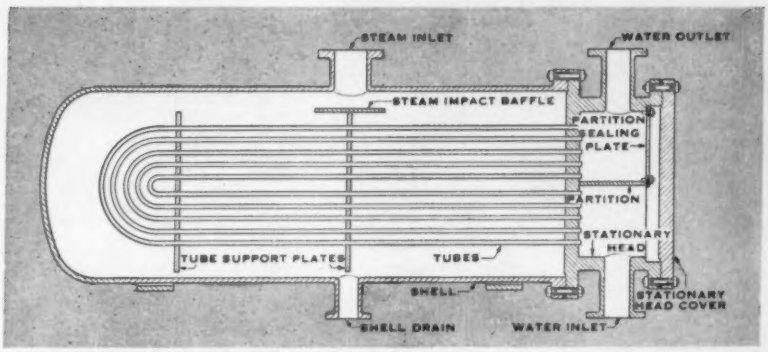
Where relatively high pressures are involved—as in power station feed-water heaters and many exchangers for oil refineries, chemical, and petro-chemical plants—it is very costly to get increased capacity by increasing shell diameters beyond about 48".

It is more economical to lengthen the equipment. And this means longer tubes —either as straight lengths with a floating head or as U-bend tubes.

U-bend Tube Design of exchangers has several inherent advantages, particularly when wide temperature differences exist in the unit. Each U-bend tube individually takes care of its expansion stresses. The number of rolled tube joints is cut in half. The absence of a floating head eliminates one gasketed joint and reduces the total weight of the tube bundle, making handling easier.

The average length of tubes involved is already beginning to crowd the heretofore standard maximum of 60 feet. And The American Brass Company, recognizing the trend to still greater length, has installed new mill equipment to produce tubes up to 100 ft. in straight lengths—in U-bends with the length of the straight leg up to 50 feet. The radius of the bend to the center line can be as small as 1½ times the outside diameter of the tube, or as great as 30 inches.

Dual-gage Tubes. For the tubes with short-radius bends in the middle of the bundle, provision should be made for extra metal at the bend to prevent thinning of the tube wall below a safe minimum for the service. Dual-gage tubes are made with extra wall thickness in the area of the bends. This cuts cost and weight, as the extra metal is only at the bends where it is needed and not down the entire length of the tube. Cost savings have been estimated at from a few cents to several dollars a tube, depending on the alloy used. The American Brass Company makes dual-gage tubes one BWG thickness heavier in the bend area.

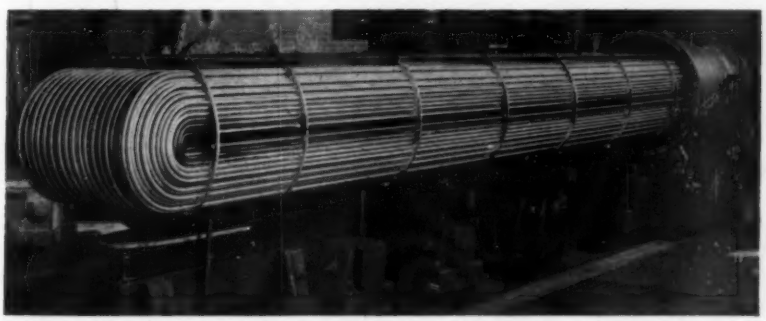


Schematic drawing of U-bend-tube-design feed-water heater. *Courtesy The Griscom-Russell Co.*

Annealing. Both single-gage and dual-gage tubes are annealed at the bend to relieve stresses developed in the bending process, which otherwise might lead to stress-corrosion cracking.

Testing. Tube quality is particularly critical in high-pressure, high-temperature service. Furthermore, U-bend bundles are so tightly packed that it is difficult to remove a defective tube, particularly at the center. So The American Brass Company has added equipment to make hydrostatic tests up to 6000 psi on even the longest U-bend tubes after they have been bent. Air tests up to 250 psi with tube submerged in water can be made on straight lengths up to 60 feet.

Technical Assistance. For more detailed information on extra-long tubes, U-bend, Dual-gage, or Duplex tubes to meet special problems, address: The American Brass Company, Buffalo Division, Buffalo 5, New York. In Canada: Anaconda American Brass Limited, New Toronto, Ont. 5876



Compact tube bundle for a feed-water heater using U-bend tubes averaging 45' long. Similar units have been made with tubes up to 85' long.

ANACONDA®
TUBES AND PLATES FOR
CONDENSERS and HEAT EXCHANGERS
Made by
THE AMERICAN BRASS COMPANY

For more data circle 516 on Post Card

ROTOJET®

Cleans TUBES and PIPES

ANY SIZE

from ½" to 12" I.D.

STRAIGHT or CURVED

Roto engineers are constantly designing new equipment to meet new conditions and applications for its tube cleaners. If you have a pipe or tube cleaning problem, we will be pleased to place our long specialized experience at your disposal. Write, wire or

Phone HUmboldt 3-0570

Illustrated are a few of the many types and sizes of Rotojet Tube Cleaners driven by air, steam or water. We analyze each application before recommending equipment that best meets the requirement.

ELLIOTT COMPANY – ROTO PLANT

Tube Cleaner Specialists Since 1910

147 Sussex Avenue, Newark, N. J.

For more data circle 517 on Post Card

and physical and thermal properties of the material listed. Johns-Manville.

FOR NUCLEAR APPLICATIONS

145 Nuclear Equipment — New devices for remotely handling radioactive, toxic or highly flammable materials are described in this 20-pp booklet. Illustrates and describes the Mechanical Arm which provides the sensitive touch required in handling delicate instruments weighing less than an ounce, as well as the strength and agility required to lift and accurately position loads of several tons. Mechanical Div., General Mills, Inc.

146 Water for Nuclear Plants — Technical Reprint T-162 discusses reasons for extreme water purity requirements in nuclear cycles, including considerations of heat transfer, radioactivity, corrosion etc. Tells how purification is accomplished by "polishing" condensate in nuclear cycles with scavenger demineralizer equipment. Graver Water Conditioning Co.

147 Magnetic Amplifier Systems — Eight-pp Bulletin S-963 on magnetic amplifier systems for nuclear reactor installations, describes a rod programmer amplifier installation. A functional diagram outlines an integrated static control system for a nuclear reactor power installation. Details of magnetic amplifier servo drives, hydraulic valve control and remote handling control, as well as engineering specifications and transfer characteristics of the units included. Magnetic Amplifiers, Inc.

148 On Nuclear Graphite — Technical data on manufactured graphite for nuclear applications is contained in 8-pp Catalog Section S-4905. Gives tabular data on average properties, as well as comparative data on graphite vs other materials for moderators and reflectors. Illustrated text describes use of graphite as a neutron moderator, a neutron reflector, thermal column or subcritical pile, reactor shielding and control rods, fuel elements and molds and crucibles for nuclear metals. National Carbon Co., Div., Union Carbide Corp.

OTHER EQUIPMENT

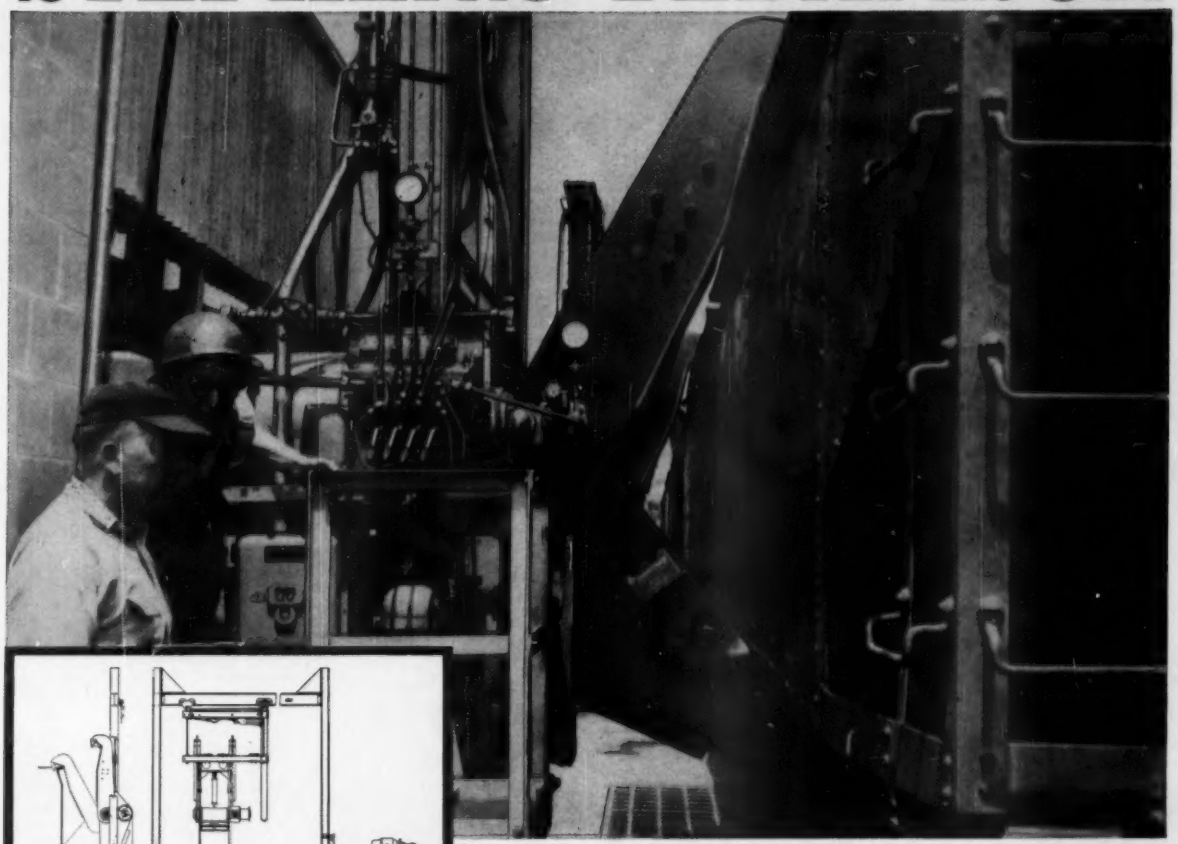
149 Gas Turbine Drivers — Bulletin 166 presents a 10-pp analysis of the economic aspects of combustion gas turbine application in the refining industry. Particular emphasis is given to turbine design, operating characteristics and profitable use of a turbine's double function as a source of power and heat. Performance charts on fuel consumption, exhaust gas flow are included. Clark Bros. Co.

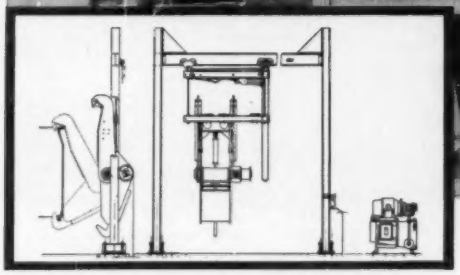
150 Deaerating Heaters — Revised Bulletin WC-106A, 12 pp, on tray-type deaerating heaters, covers principles of deaeration, tray heater operation, standard design and applications, accessory equipment. A section on design discusses load variations, installation, metallurgy and construction of trays and vent condensers. Graver Water Conditioning Co.

151 Distillation Unit — This bulletin describes company's thermocompression seawater distilling unit, stressing its economy, low corrosion and non-scaling features and simplicity of operation. Mechanical Equipment Co.

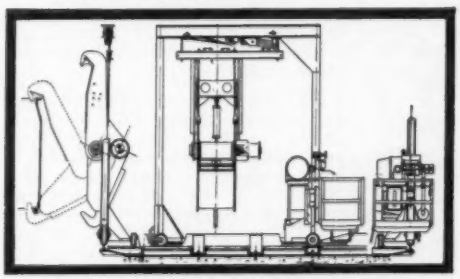
152 Scale Remover — Advantages of company's "Dry Lightning" agent for scale removal from piping, coils, pumps,

STEPHENS-ADAMSON





TYPE "B" STATIONARY MOUNTED CARQUAKE
Designed for applications where only slight movement parallel to hopper cars and tracks is required. The unit is mounted to the customer's concrete hopper foundation or steel structure with anchor bolts.



TYPE "C" RAIL MOUNTED CARQUAKE
Mounted on rails permitting travel any desired distance and unloading into any hopper. Concrete piers or steel structure for anchoring rails are all customer need furnish.

NOW! MINIMUM NOISE WITH MAXIMUM EFFICIENCY IN UNLOADING HOPPER CARS

HYDRAULICALLY POWERED

SA CARQUAKE

- One man unloads hopper-bottom railroad cars quickly, efficiently and with less noise than overhead car shakeouts.
- Hydraulically powered vibration with speed controlled to match required capacity.
- No expensive overhead structures needed — a completely self-contained unit—unlimited movement parallel to track.
- Avoids demurrage charges — saves manpower — speeds unloading operations.

WRITE FOR BULLETIN 658

S-A

ENGINEERING DIVISION
STEPHENS-ADAMSON MFG. CO.
GENERAL OFFICE & MAIN PLANT, 86 RIDGEWAY AVENUE, AURORA, ILLINOIS
PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
BELLEVILLE, ONTARIO

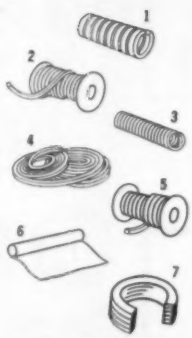
For more data circle 518 on Post Card

A mechanical packing problem . . .

HOW AN R/M DISTRIBUTOR STOPPED REJECTS AND SHUTDOWNS ON AN AUTOMATIC MOLDING MACHINE

To avoid rejects and shutdowns, a large manufacturer came to R/M for advice on this automatic rotary molding machine. A packing was needed that would control leakage of hydraulic fluid into the mold with resulting shutdown. R/M Vee-Flex® Packing Rings, one of the Big 7 Packing Types, were recommended and proved to be the answer. Since then the machine has been operating daily for 3 years under a pressure of 1000 psi and at approximately 200°F without need of repacking.

The solution to your own packing problems is as handy as your telephone. The R/M distributor near you has a wide range of experience that is yours for the asking. Remember, too, the R/M Big 7 packing family is carefully engineered for your specific job. Write for your distributor's name and address today.



THE BIG 7 PACKING TYPES

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

R M

BIG 7 PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics
Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings
Brake Blocks • Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

For more data circle 519 on Post Card

compressors, condensers and other equipment are detailed in this informative pamphlet. How to use the material is covered. Western Chemical Co.

153 On Model Studies — Advantages of model studies for precipitators and other gas handling systems are presented in this 18-pp brochure. Discusses three plans under which this new engineering service is available. Several case histories are detailed to show benefits obtained. Also provided are articles on the subject reprinted from POWER ENGINEERING and other publications. Research-Cottrell, Inc.

. . . Outstanding Among This Month's Catalogs

154 59 Good Ideas — Titled, "59 Ideas for Modernization in '59," this 20-pp booklet presents specific examples of company's products in a wide range of industrial operations. Each brief, illustrated case history, tells how the particular product development contributes to more efficient operation, makes possible a saving in operating costs, solves a specific problem, promotes greater safety etc. Electrical, pumping and materials handling equipment covered. Allis-Chalmers Mfg. Co.

155 On Air Motors — Sixteen-pp Form 5072A features over 100 air motors covering a power range from 0.3 to 24 hp, with speeds from 50 to 2580 rpm. Both multi-vane and piston motors are listed with specifications and dimension drawings. Eight illustrated case histories show how these motors save time, money and manpower in typical applications. Cutaway photos show design and construction details of the motors. Also provided is typical air motor power curve, and information on remote control operation. Ingersoll-Rand Co.

156 More KW per Dollar — This 34-pp brochure discusses architectural, mechanical and electrical uses for aluminum in electrical power generating stations. Presents 60 types of applications where use of aluminum means initial, installed or service-life savings. Applications covered are based on specific existing installations ranging from switchyard bus conductors, siding and ducts to such newer uses as switchyear structures, die-cast stair treads, and tubes for surface condensers. Aluminum Co. of America.

157 Steel Buyers' Guide — "Buyers' Guide for Stainless Steel Products and Services," is a 159-pp book listing some 3000 firms making products of stainless steel or offering services pertaining to stainless steel. Contains 188 specific and general product categories followed by manufacturers' names. Many of the listings of fabricators and those who perform services are arranged geographically. A special table lists mill suppliers and the forms and shapes they produce. Book is available to qualified power engineers. Please state your job title, when requesting it. American Iron and Steel Institute.

158 Pillow Block, Flange Bearings — Twelve-pp Bulletin 106 describes new pillow block and flange bearings, including types for normal and light duty applications. Describes and illustrates design

In Florida power plant...

quantichem analyzer records dissolved oxygen colorimetrically 0 to 30 ppb.

EVEN a few parts per billion of dissolved oxygen in water for power station boilers reduces overall efficiency and economy. Three months ago, the Florida Power Corp., St. Petersburg, Fla., put on stream a Milton Roy Quantichem colorimetric analyzer in its Bayboro Station to survey dissolved oxygen in returned condensate from steam turbine condensors.

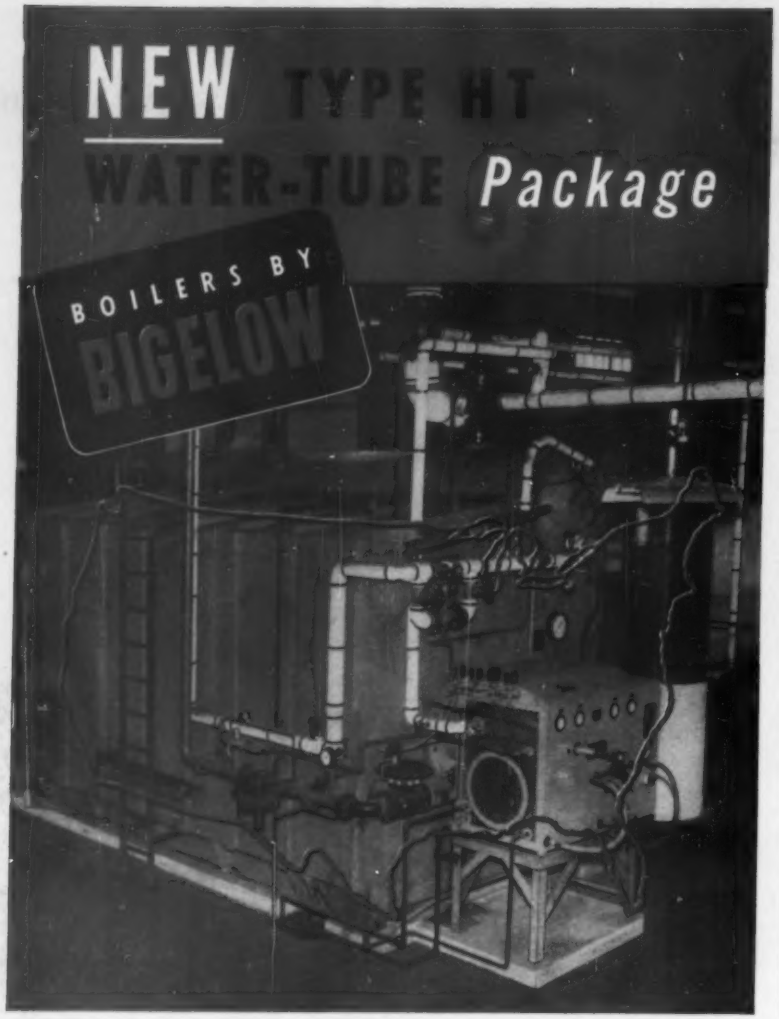
In addition to this application, other Quantichem automatic analyzers are available for analyses of silica (0-50 ppb), residual chlorine (0-3 ppm), hardness (0-3 ppm) . . . as well as for phosphates, hydrazine, chlorides, and many others.

Write for information on your particular application.
Milton Roy Company, 1300 East Mermaid Lane,
Philadelphia 18, Pa.

milton Roy
CHEMICAL INSTRUMENTATION SYSTEMS

Controlled Volume Pumps
Quantichem Analyzers • Chemical Feed Systems

For more data circle 520 on Post Card



Delivered "READY-TO-OPERATE" From Coast To Coast

Bigelow's latest "one-piece" answer to a wide range of steam problems has already proven successful in installations from Maine to California. This water-tube "packaged" boiler includes burner, forced-draft fan, feed water regulator, soot blower, valves, refractory, insulation, controls and accessory equipment. It is shipped complete—ready to operate as soon as service connections are made.

Advantages
Cuts Installation Costs and Time... Requires Small Space... Portable... Simple To Operate... Fast Steaming With Safety, Efficiency and Economy ... Low Maintenance... Handles Quick Load Changes Easily and Efficiently... Wide Range Of Service... Burns Oil or Gas.

Available in standard sizes for capacities ranging from 8,000 to 45,000 lbs. of steam per hr. Write for this new, complete illustrated catalog.

THE BIGELOW COMPANY, NEW HAVEN 2, CONN.
Founded 1833
BIGELOW REPRESENTATIVES: Boston • New York • Chicago • Orangeburg, S. C. • Philadelphia • Syracuse • Detroit • Washington, D. C. • San Francisco • Atlanta • Los Angeles • Milwaukee • New Orleans • Petersburg, Va. • Seattle • Indianapolis • Kansas City, Mo. • Tulsa • Salisbury, Md. • Greensboro, N. C. • Cleveland • Cincinnati
B1-19

For more data circle 521 on Post Card

features, and provides dimensional and load data. Hoover Ball and Bearing Co.

159 Convertor Selection — Twelve-pp Bulletin 303-A shows how to select hot water heating convertors, and contains construction and operating data. Information includes product dimensions, connections, operating capacities, temperatures, and pressure losses covering usual ranges for standard water heating systems and general ranges for radiant heating systems. Patterson-Kelley Co., Inc.

160 Flexible Hose — Finger-Flexible Teflon hose for industrial and other applications is described in 6-pp Bulletin 400. Construction features are detailed and specifications and ordering data given in illustrated form, along with a performance chart for convoluted hose, lists of hydraulic and other applications. Titeflex, Inc.

When ordering catalogs, allow time for us to relay your requests to the manufacturers—and for them to mail out copies. Remember, manufacturers are often swamped with catalog requests.

161 Horizontal-Grate Cooler — Bulletin CO-6 describes and illustrates company's horizontal-grate cooler designed to cool materials discharged from rotary kilns, sintering machines, roasters, and various types of furnaces. Advantages are detailed, and a schematic diagram of the cooler and photos showing typical installation are included. Fuller Co.

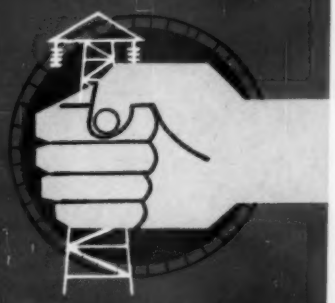
162 Watertight Concrete — A summary of authoritative thought on the design and specification of watertight concrete is given in 6-pp folder. Covers basic requirements and tells how Pozzolith reduces permeability, shrinkage, bleeding and segregation to produce strong, durable structural concrete resistant to water penetration under normal conditions. The Master Builders Co.

163 Spray Products — Information on the history of spray products and their applications is provided in this 16-pp booklet. Covers aerosol packing, development of pressure containers and valves, methods of filling and principles of operation. Lists manufacturer's aerosol products including rust inhibitor, plastic spray, tool maker's ink and cleaning oil, lubricating oil, wire rope lubricant, multi-purpose grease, open gear grease, color code paint, touch-up paint. Crown Industrial Products Co.

164 Red Lead Primer — Paint with a red lead-iron oxide-zinc dust pigmentation in an alkyd resin vehicle for protection of galvanized steel surfaces is described in Technical Letter 13. Composition of formula is broken down, and details on surface preparation given. Lead Industries Association.

165 Electro-Mechanical Kits — Sixteen-pp Bulletin TDS-1110-1 provides features and specifications on electro-mechanical assembly components, including mounting components, component hangers, component clamps, bearing hangers, shaft components, gears, service units, limit stops, switch assemblies and clutches and differentials. Features and advantages are detailed and mounting diagrams included. Servo Corp. of America.

More Power,
More Economies
at Savannah



To meet fast-mounting demands in Georgia for more power, more economically produced, Stone & Webster Engineering Corporation recently completed Unit #1 of Savannah Electric and Power Company's Port Wentworth Station. This initial installation, with a capability of 55,000 kw, will soon be followed by another unit of somewhat larger capacity.

In both design and construction, Stone & Webster worked closely with the utility's own people to produce one of the most efficient and highly automated thermal electric generating stations of its size in the world.

Stone & Webster invites your inquiries concerning its broad engineering skill and experience in the power field.

Write or call our nearest office

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto

How Commonwealth Edison Turned a Fly Ash Problem Into Profit

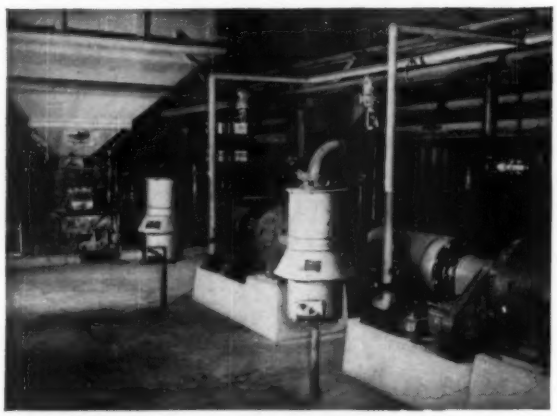
At Commonwealth Edison's State Line Station, about 350 tons of fly ash a day had to be wet down, loaded, and trucked to suitable dumping sites.

Waste becomes profit. Today, the plant burning a peak load of 5000 tons of coal daily collects dry fly ash automatically in a totally enclosed Fuller-Kinyon system. The ash is conveyed from precipitators to storage bins and silos, where it's sold as a by-product. Manpower: just three men, one at the main control panel and two bagging the ash for sales to local contractors.

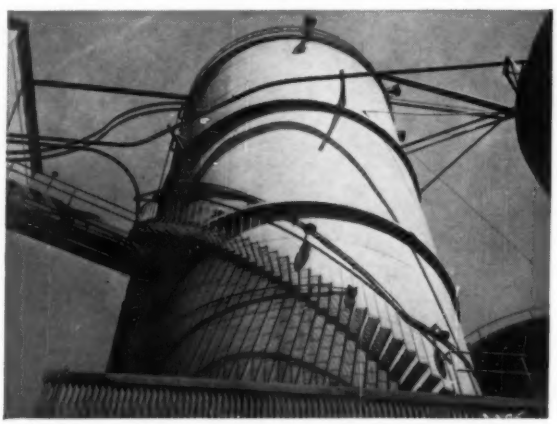
Air and gravity do the work. F-H Airslide® conveyors fluidize dry fly ash by a column of low-pressure air for easy movement by gravity to central surge hoppers. Then, a Fuller-Kinyon pump under each hopper drives the ash by air through a five-inch line to storage. The system is practically maintenance-free. There are few moving parts to foul or wear out.

Large and small plants can get the benefits of Fuller-Kinyon fly ash handling. Capacities range from 100 to 8,000 cubic feet an hour. F-H Airslide and Fuller-Kinyon conveying lines can be curved to avoid beams and other obstacles. Low-pressure air provides power inexpensively and installation costs are significantly less than other types of conveying systems. Write for detailed information in Bulletin FF-49-1.

F-H AIRSLIDE FLUIDIZING CONVEYORS ANGLE DOWNWARD from precipitator hoppers, move air-activated ash to 20-ton central surge hoppers under floor. There are few moving parts.



FULLER-KINYON PUMPS AND COMPRESSORS under surge hoppers propel ash to bins and silos at 20 tons an hour. Fluidized by air, the abrasive, 300°F. ash moves without injuring system.



BULK SILOS receive air-conveyed ash through Fuller-Kinyon pipe-lines. Farthest silo is 1,000 feet from pumps. Over 50% of fly ash is bagged and sold as a by-product.

Fuller
....pioneers in harnessing AIR

1335
G-203

FULLER COMPANY
150 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Birmingham • Chicago • Kansas City • Los Angeles • New York • San Francisco • Seattle

FULLER COMPANY GENERAL AMERICAN TRADE MARK

For more data circle 523 on Post Card

POWELL

world's largest family of valves

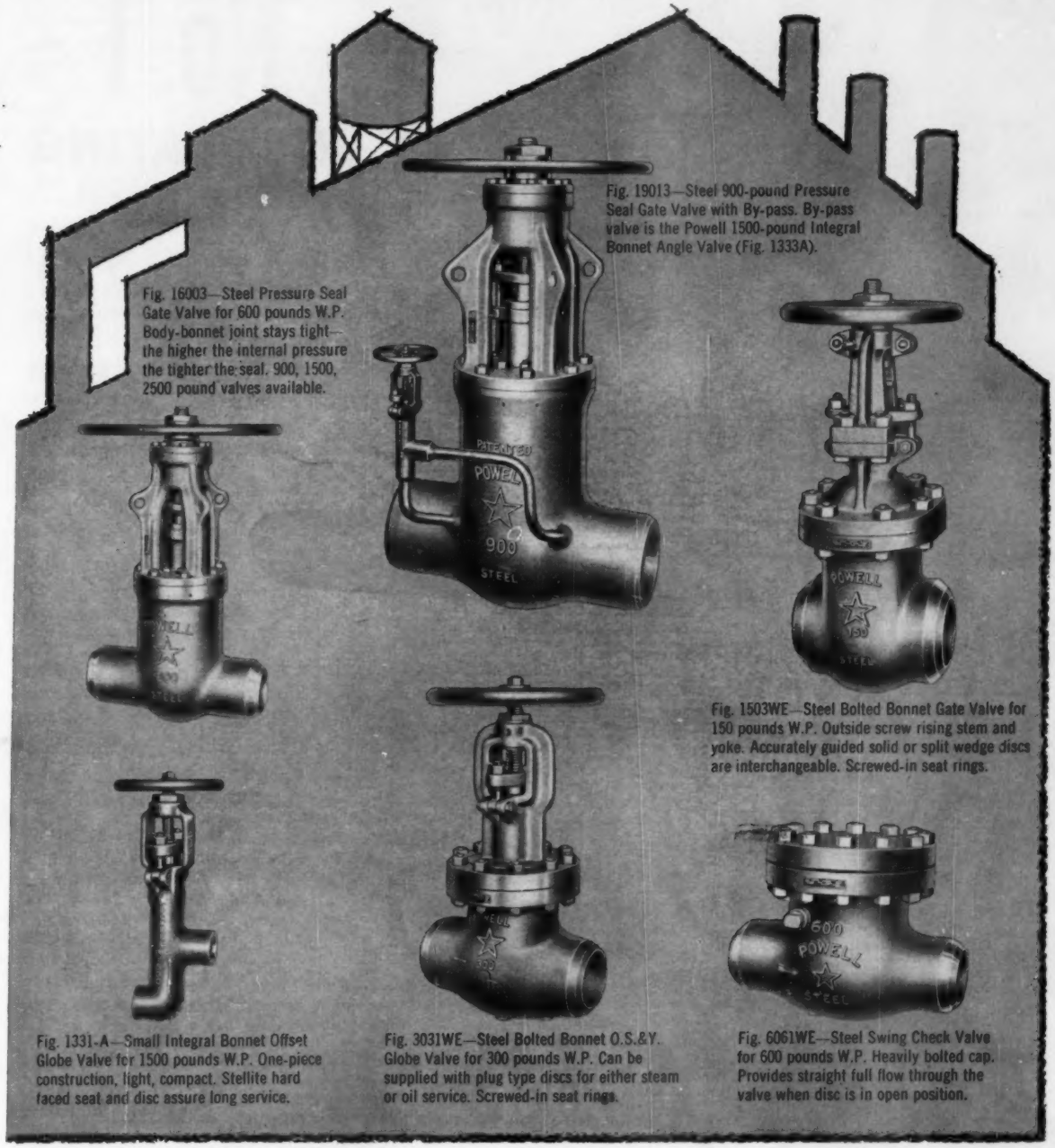


Fig. 19013—Steel 900-pound Pressure Seal Gate Valve with By-pass. By-pass valve is the Powell 1500-pound Integral Bonnet Angle Valve (Fig. 1333A).

Fig. 16003—Steel Pressure Seal Gate Valve for 600 pounds W.P. Body-bonnet joint stays tight—the higher the internal pressure the tighter the seal. 900, 1500, 2500 pound valves available.

Fig. 1503WE—Steel Bolted Bonnet Gate Valve for 150 pounds W.P. Outside screw rising stem and yoke. Accurately guided solid or split wedge discs are interchangeable. Screwed-in seat rings.

Fig. 1331-A—Small Integral Bonnet Offset Globe Valve for 1500 pounds W.P. One-piece construction, light, compact. Stellite hard faced seat and disc assure long service.

Fig. 3031WE—Steel Bolted Bonnet O.S.&Y. Globe Valve for 300 pounds W.P. Can be supplied with plug type discs for either steam or oil service. Screwed-in seat rings.

Fig. 6061WE—Steel Swing Check Valve for 600 pounds W.P. Heavily bolted cap. Provides straight full flow through the valve when disc is in open position.

For every flow control problem Powell offers more kinds or types, available in the largest variety of metals and alloys to handle every flow control requirement. Powell distributors are located in all principal cities and maintain inventories to fill almost any need. For special engineering problems, write direct to:

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

For more data circle 524 on Post Card

Mold a Heat-Saving Overcoat on Hard-to-Fit Shapes with ...BALDWIN-HILL

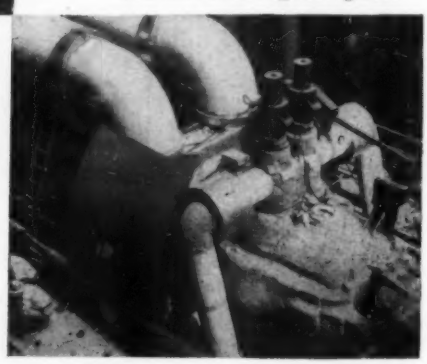
No. 1 INSULATING CEMENT

On such complicated shapes as this steam turbine shell and its exhaust piping at Philadelphia Electric Company's Schuylkill Station, B-H No. 1 Insulating Cement was applied easily and quickly to the irregular surfaces.

Because No. 1 Cement is effective to 1800° F, applicators were able to apply the proper thicknesses of insulation to compensate for the varying surface temperatures of the different zones of the turbine. For instance, on the high pressure shell, 10″ of cement was applied on the hottest (1050° F) and 7½″ on the coolest (800° F) sections.

An added advantage, for maintenance purposes, is that No. 1 may be removed from equipment where temperatures have not exceeded 1200° F and reapplied elsewhere. And a rust inhibitor prevents any corrosion of metal under the cement.

For more information on B-H No. 1 Insulating Cement and other B-H Insulations, write for Catalog or see it in Sweet's Plant Engineering File.



BALDWIN-HILL *Company*

BALDWIN HILL BH INSULATIONS

CONTRACT APPLICATION SERVICE AVAILABLE

202 Breunig Ave., Trenton 2, N. J.

Kalamazoo, Mich. . . Huntington, Ind. . . Temple, Tex.

For more data circle 525 on Post Card

Hall Industrial Water Report

VOLUME 7 FEBRUARY 1959 NUMBER 1

Let's Get This Clear

Day after day new products are being developed to improve the clarification of water. The standard coagulants, aluminum and iron sulfates, have long been supplemented with aids like clay and magnesium oxide. Some 20 years ago Baylis developed activated silica. But today new materials to assist clarification with the standard coagulants are coming along faster and faster. They are designed to improve removal of color, bacteria and suspended material from potable and industrial water, to cut costs by reducing coagulant consumption, to assist in removal of deleterious materials from waste water and to assure optimum operation of clarifiers and filters.

Hall Laboratories research and development continually provides improved coagulant aids, field tested for performance. Furthermore, Hall engineers know clarification equipment and processes. They are ready to help you improve clarification or reduce water treatment cost.

Feeding Ferric Sulfate

Ferric sulfate is a commonly used coagulant. When fed with a solution feeder, care must be taken to get the chemical completely into solution. Otherwise, undissolved material will cause trouble in the feeding equipment and effectiveness will be lost.

Each pound of ferric sulfate liberates about 260 BTU when it goes into solution. The resulting solution temperature increase has an important effect on rate of solution. If tap water temperature is too low, or if the ratio of water to ferric sulfate is too high, there will be troublesome undissolved material. Furthermore, final solution temperature should be 90°–100° F.

The practical trick for easy handling is careful adjustment of the water-to-chemical ratio. If water temperature is 68° F., dissolution of ferric sulfate will be complete in 18 minutes and final solution temperature will be about 98° F., if the ratio of water to solid ferric sulfate by weight is five. If water temperature is only 47° F., the solution rate and final temperature will remain the same, provided the ratio of water to chemical is cut to three. These examples may be used as a guide; obtain complete dissolving information from the manufacturer of the material used.

Water Color Problem

An Eastern woolen mill is located downstream from other woolen mills, a steel mill and a sewage plant. Needless to say, the river water is badly contaminated with organic coloring matter, suspended matter and detergents during summer droughts and extremely cold weather. Clarification has been difficult. Even with heavily increased alum dosages color removal was poor. This was a costly situation because it frequently necessitated reprocessing of the delicate pastel shades which are a specialty of this mill.

More than two years ago Hall Laboratories introduced the plant to coagulant aids. After laboratory jar tests were carried out to determine the type of aid best suited to this particular case, the plant adopted the use of a Hagan aid during periods of high color. Not only have floc formation, sedimentation and color removal been greatly improved, but alum dosage has been reduced by 25%. The plant operators say they feel sure they would have had to suspend operations during the 1957 drought if they had not been using the Hagan coagulant aid.

No Clarifier Needed

A growing Southern textile plant was forced to curtail operations because water requirements exceeded the total capacity of the wells. Further expansion was anticipated. The additional water required would have to come from a surface supply.

Faced with the installation of expensive clarification equipment and costly chemical treatment to make the water suitable for process work, the plant called on Hall Laboratories to study the problem. Hall engineer R. E. Elliott carried out the survey and came up with a money-saving answer. He found that a lot of water could be saved by re-using cooling water from closed heat exchangers, by repairing overflow mechanisms and by using untreated surface water for non-critical operations. No treatment of surface water would be necessary and enough good quality well water would be saved to permit *doubling* current operations.

Potential Trouble

When Hall engineer Peter Benes began service work at a Southern chemical plant he found a clay-like deposit accumulating in the sodium cycle units of the split-stream softeners. Because of previous bad experiences with aluminum in boiler water, Benes became alarmed when analysis showed the deposit to contain considerable aluminum.

Further analytical work traced the aluminum to the clarified and filtered makeup water. Clarification was accomplished with aluminum sulfate; but operation and pH value were such that there should have been very little aluminum in the filtered water. Benes kept digging. He found that soda ash, used to adjust upward the pH of the clarified water, was being added ahead of the filters. This resulted in dissolution of some of the small amount of suspended aluminum hydroxide floc passing to the filters.

Immediate change was made to feed the soda ash after the filters. Aluminum concentration of the filtered water dropped from 0.15 ppm to 0.05 ppm and the problem was solved.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information on how the Hall System can help you solve your particular water problems, write, wire or call address below.

Water is your industry's most important raw material. Use it wisely.

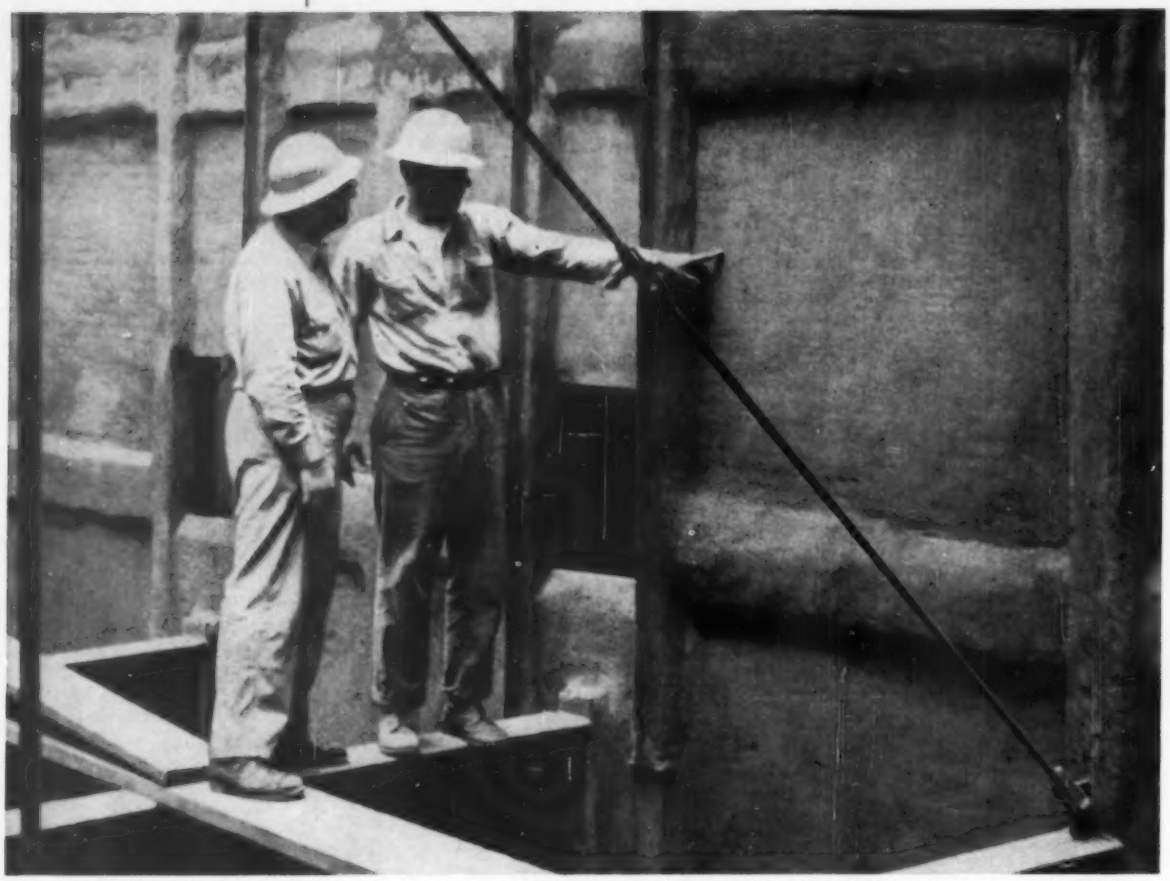
HALL LABORATORIES
DIVISION OF HAGAN CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

For more data circle 526 on Post Card

Con Edison cuts corrosion

Lines its new precipitator with corrosion-resistant concrete made with **Atlas Lumnite Cement**



Consolidated Edison's Astoria Station, New York · Contractor: Research-Cottrell, Inc., Bound Brook, N. J. · Gunite Contractor: J. A. McCollum, Inc., Marlton, N. J.

To withstand the corrosive effects of fly ash and gases that will soon be punishing this new precipitator, a corrosion-resistant concrete lining made with Lumnite cement was installed. Industrial concretes made with Lumnite calcium-aluminate cement and suitable aggregates resist heat, thermal shock and abrasion, as well as corrosion. Poured, plastered or gunited, such concrete linings place easily (reaching full service strength within 24 hours) and provide good insulation. For convenience, manufacturers of refractories offer castables made with Lumnite cement, packaged mixtures ready for use with just the addition of water. For more information, write Universal Atlas, 100 Park Avenue, New York 17, N. Y.

"USS," "Atlas" and "Lumnite" are registered trademarks. L-179

Universal Atlas Cement
Division of
United States Steel

OFFICES: Albany • Birmingham • Boston • Chicago • Dayton • Kansas City • Milwaukee • Minneapolis • New York • Philadelphia • Pittsburgh • St Louis • Waco

For more data circle 527 on Post Card

Leading firms use

SOLA FLEX®

Two pressure-balanced Sola-Flex joints permit axial expansion with balanced thrust

TWO OF THESE GIANT pressure-balanced Sola-Flex expansion joints permit axial expansion with balanced thrust due to internal pressure on a 225,000-kw General Electric steam turbine-generator. Part of Solar's new ring-supported line, the joints provide higher working pressures, lower stress, longer flexing life. They represent another important example of why forty of America's fifty largest businesses rely on Sola-Flex expansion joints to help solve difficult piping problems.

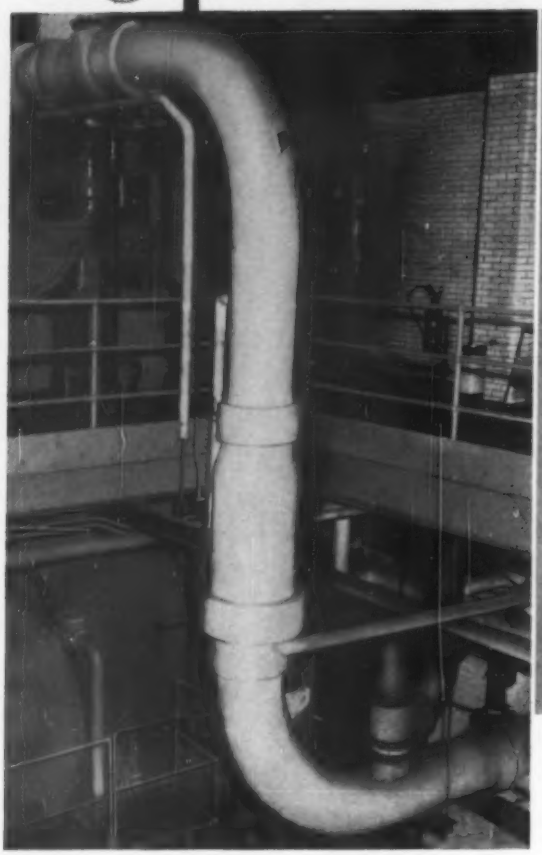
Solar manufactures the most comprehensive line of expansion joints in the world. They are made from a wide variety of stainless and high-temperature alloys in a complete range of sizes, from ½ in. to 35 ft. in diameter. Temperatures range from –320F to 1200F, pressures from complete vacuum to 600 psi and up. *And rugged, economical Sola-Flex expansion joints can be "in service" 1 to 4 weeks after order!*

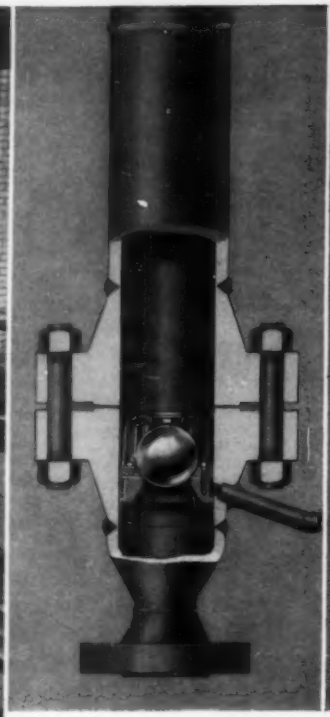
A new pamphlet describes Solar's complete line of Sola-Flex expansion joints. Write for it to Dept. F-105, Solar Aircraft Company, San Diego 12, Calif.

SOLAR AIRCRAFT COMPANY — SAN DIEGO, DES MOINES

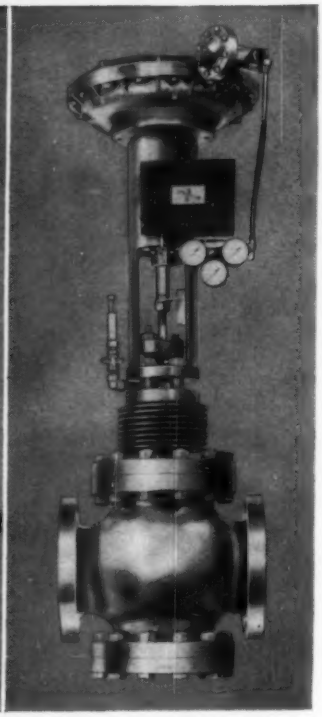
For more data circle 528 on Post Card

How Copes-Vulcan control systems boost power plant efficiency





Steel ball controls orifice opening. Incoming steam lifts the ball in an amount determined by the weight of the ball and the amount of steam flow. Pressure drop of about 3 psig is held constant at all rates of flow.



Copes-Vulcan valve . . . for regulating desuperheater cooling water. Noted for accuracy and dependability, Type CV-D diaphragm-operated valve is available in sizes to 12-inch. Write for Bulletin 1027.

New Copes-Vulcan Desuperheater handles the tough temperature control jobs

Using a unique design principle Copes-Vulcan's newly developed Variable-Orifice Desuperheater* provides superior temperature control demanded on the most critical job. Installed in a steam header supplying a 12,500-kw turbine-generator, this desuperheater holds temperatures within a plus-or-minus 3F limit—even though it is located just 20 feet upstream of the turbine throttle.

With only one outside connection and only one moving part, the Variable-Orifice Desuperheater simplifies maintenance. Skillful design eliminates the need for long runs of piping, atomizing steam, spray nozzle and glands.

The Variable-Orifice Desuperheater is one of several types—each engineered to meet particular operating requirements. Write for Bulletin 1037.

Single source . . . custom design . . . skilled service

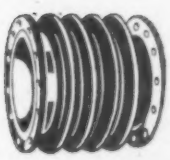
Desuperheaters are a part of Copes-Vulcan's complete line of control systems for superheat and reheat temperatures, feed water, combustion and pressure reducing operations.

Available in separate units or integrated into a single package, these control systems are custom-designed to meet individual specifications, and are serviced periodically by experienced Copes-Vulcan field engineers. For a survey of the line, write for Bulletin 1022-B.

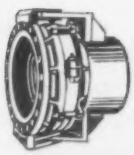
*Patent applied for.

Copes-Vulcan Division
BLAW-KNOX COMPANY
Erie 4, Pennsylvania

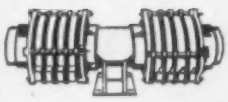
For more data circle 524 on Post Card



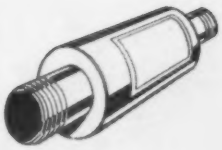
Free-Flexing Expansion Joints



Hinged Expansion Joints



Dual Expansion Joints



Expansion Compensators

Flexible Connectors

Controlled-Flexing Expansion Joints

Balanced Expansion Joints

THE COMPLETE LINE TO TAKE CARE OF ANY KIND OF PIPE MOTION

Flexonics has the equipment – as well as the experience and the skill – to take care of any kind of pipe motion problem. Here's where you benefit from more research . . . more metallurgical care . . . more service . . . and now standard stock sizes for quick delivery from Flexonics warehouses. They all add up to expansion joints that you can *install and forget* – plus expansion compensators, flexible connectors, and the all-new Flexonics pipe alignment guides–to take care of any kind of pipe motion!

Today–write for your copy of the Flexonics Expansion Joint Design Guide . . . 28 pages of valuable information.

Member Expansion Joint Manufacturers Association

EJ-235

Flexonics

EXPANSION JOINTS

FLEXONICS CORPORATION • 1374 SOUTH THIRD AVENUE • MAYWOOD, ILLINOIS

Divisions

INDUSTRIAL HOSE • EXPANSION JOINT • BELLOWS • AERONAUTICAL • AUTOMOTIVE

Flexonics Research Laboratories, Elgin, Illinois

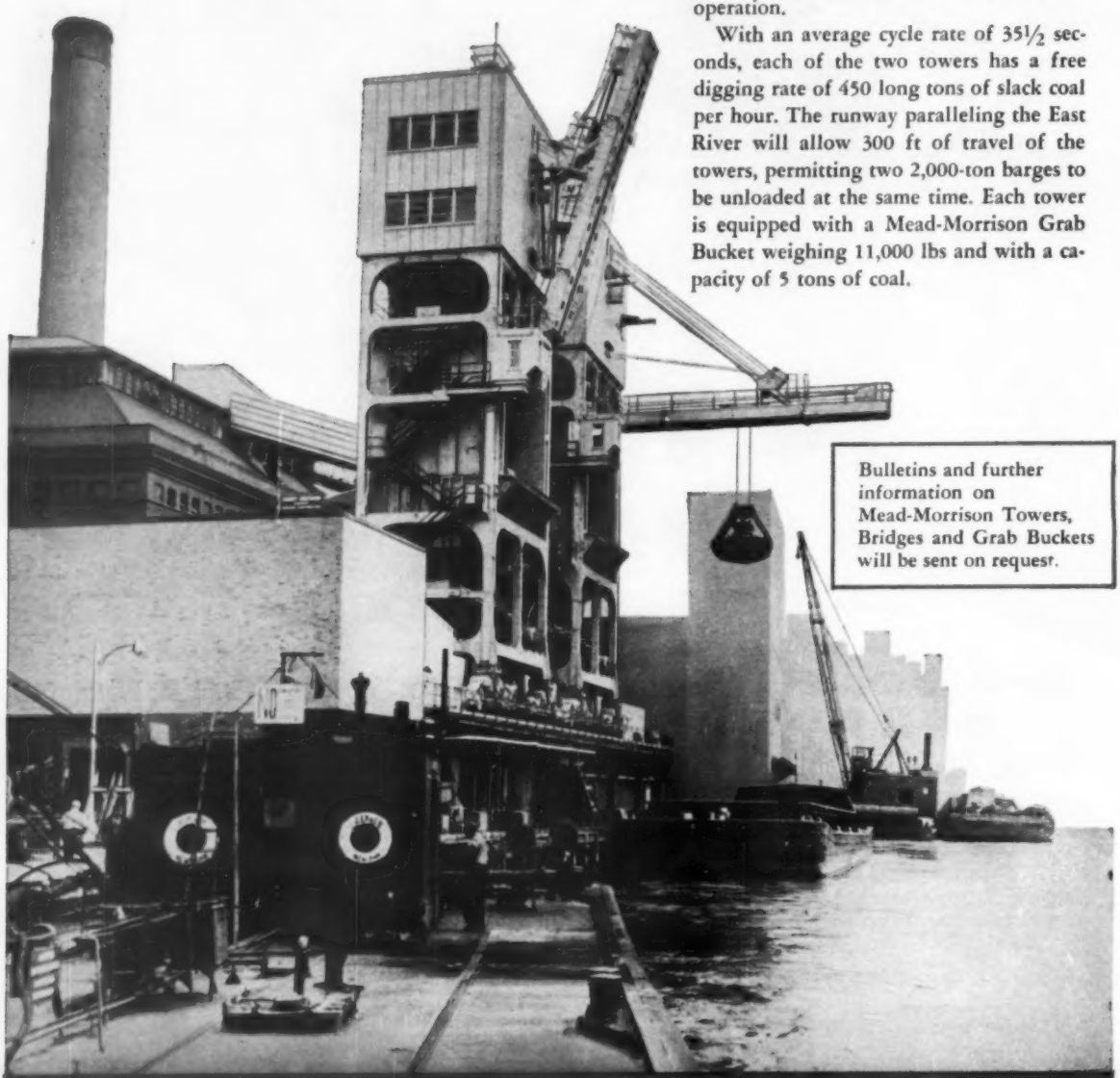
In Canada: Flexonics Corporation of Canada, Limited, Brampton, Ontario

For more data circle 530 on Post Card

Speedy coal handling
for a New York subway power plant

The power station of the New York Transit Authority at 74th Street and East River has installed two new Mead-Morrison Coal Unloading Towers as part of its extensive modernization program to increase subway power. Because of their prominent position alongside the East River Drive, the towers were specially designed by Mead-Morrison to meet aesthetic standards as well as to include the most modern features for efficient operation.

With an average cycle rate of 35½ seconds, each of the two towers has a free digging rate of 450 long tons of slack coal per hour. The runway paralleling the East River will allow 300 ft of travel of the towers, permitting two 2,000-ton barges to be unloaded at the same time. Each tower is equipped with a Mead-Morrison Grab Bucket weighing 11,000 lbs and with a capacity of 5 tons of coal.



Bulletins and further information on Mead-Morrison Towers, Bridges and Grab Buckets will be sent on request.

MEAD-MORRISON

Division of McKIERNAN-TERRY CORPORATION · Manufacturing Engineers

HARRISON, NEW JERSEY

MK825

For more data circle 531 on Post Card

ATOMICS

A section of POWER ENGINEERING covering current and forthcoming developments in the field of Nuclear Power throughout the world

ANDREW W. KRAMER
Editor

CONTENTS

ALPR—A Small Nuclear Power Plant 43
The Argonne Low Power Reactor disproves the idea held in the early years of atomic energy development, that nuclear power plants, of necessity, would have to be very large. ALPR has a capacity of 300 kw, electrical, and serves a 400 kw heating load.

ALPR Provides Power and Heat 44
The Argonne Low Power Reactor is unique among nuclear power plants, first because it has an electrical capacity of only 300 kw, and secondly because it is the first power reactor built in the United States to supply steam for space heating. This plant was built as a prototype for small plants to be used by military establishments in remote installations.

Disposal of Radioactive Wastes From Nuclear Power Plants 49
In the future development of nuclear power plants, no problem is more difficult or more serious than that involving the disposal of radioactive wastes from such plants. This short article on the subject discusses some of the methods being considered and certain of the economic aspects.

New Nuclear Literature 50

ALPR—A Small Nuclear Power Plant

DURING THE PERIOD immediately following the end of World War II, after the impact and astonishment of Hiroshima and Nagasaki had somewhat worn off, there was considerable speculation on the part of experts and laymen alike on the possibility of building atomic power plants. Disclosure of the miraculous fact, that the energy contained in a single pound of uranium-235 was equivalent to that of three million pounds of coal led to all sorts of fantastic conjectures—a lump of uranium the size of a marble would drive an automobile for its mechanical lifetime, houses would be constructed with a built-in fuel supply, each house would have its own electrical plant, and so on. These fanciful notions were soon dispelled, however, by scientists who, in explaining the methods for generating power from nuclear energy, made it rather obvious that nuclear energy was intrinsically a large-scale phenomenon and that it would be applicable only in large power plants. Minimum size plants of a hundred thousand kilowatts were mentioned. Nuclear energy did not appear feasible for small power plants.

This thinking was based on rather good evidence. The only reactors then in operation were the huge Hanford reactors for producing plutonium, and while nobody not actually involved in their design or operation knew how large they were, the fact that it took great quantities of Columbia River water to cool them was ample proof of their large capacity. Even the first Clinton pile ran at around 2000 kilowatts but, of course, this was purely an experimental project.

Through the years, nuclear power has remained essentially large-scale in its practical development but thinking with regard to its feasibility for small projects has changed in the light of developing knowledge. It is now known that the critical mass of a reactor can be quite low. A case in point is the recent TRIGA reactor which became critical with just 2 kg (4.4 lb) of U-235. As a result of this increasing knowledge interest has developed in small nuclear power plants for use by the military services in remote parts of the world where conventional fuels are not available. The first of these was APPR, the Army Package Power Reactor at Fort Belvoir, Va., with an electrical capacity of 2000 kw. This pressurized water plant, however, is still relatively large compared with the new ALPR described in this issue. Capable of supplying 200 kw of electricity and 400 kw of space heat, the Argonne Low Power Reactor is undoubtedly the smallest nuclear power plant to go into service at the present time. Furthermore, this is a truly competitive power plant, since the cost of delivering diesel oil to the remote locations where ALPR will be used would run as high as $1.50 to $2.00 per gallon.

Andrew W. Kramer

Fig. 1. View of the Argonne Low Power Reactor and Support Facilities Building in Idaho

ALPR Provides Power and Heat

The Argonne Low Power Reactor is unique among nuclear power plants, first because it is the first very small plant with an electrical capacity of only 300 kw, and, second, because it is the first power reactor in the U. S. built to supply steam for space heating

IN 1955, THE Department of Defense notified the Atomic Energy Commission of the need for an air-transportable, nuclear power plant capable of supplying about 200 kw of electricity and 400 kw of space heat. The plant was to be the main power source at a small remote installation such as a DEW-Line radar station in the Arctic.

The capital cost of such a plant would exceed that of the diesel plants currently serving DEW-Line installations, but diesel fuel shipping and handling costs would be so high that the use of a reactor plant might be justified on economic grounds alone. For example, the cost of shipping fuel oil to an Arctic port, unloading it, delivering it inland by air, maintaining a landing strip, and providing terminal and intermediate storage facilities could result in a delivered fuel cost of $1.50 to $2.00 per gallon of diesel oil, and a substantial number of gallons would be needed.

It was also evident that sustaining a supply line to a remote Arctic base — difficult enough in peacetime — could become impossible in time of war. The prospect of fueling a plant for 2 or 3 years with a single fuel load weighing about 250 lb was, therefore, very attractive.

Six reactor concepts were analyzed; that for a prototype "packaged" power plant with a heterogeneous boiling water reactor submitted by the Argonne National Laboratory was selected for development by the Army Reactors Branch of the Division of Reactor Development of the AEC. This system, designated the Argonne Low Power Reactor (ALPR), utilized proved technology and offered reasonable expectation of attaining the design objective — a simple plant operating with minimum supervision.

Plants of the ALPR type are adaptable not only to the DEW-Line stations but also to many other small, fixed installations — remote, isolated, or strategically important — that need continuous, reliable power, unaffected by disrupted fuel supply lines.

The ALPR is particularly well-suited to sites in areas where there is permafrost, where water is scarce, and access is difficult or impossible except by air. The design of ALPR has incorporated features permitting adaptation to all these conditions.

In August 1955, the AEC Chicago Operations Office was given the responsibility for the design of a prototype power plant based on the requirements of the Department of Defense and the Argonne proposal. Early in 1956 Pioneer Services and Engineering Co of Chicago was selected to design both the conventional portion of the plant and the various support facilities for the prototype to be constructed at the Atomic Energy Commission's National Reactor Testing Station in Idaho.

The Argonne Low Power Reactor is a direct cycle boiling water reactor with two functions: First, to generate electrical power, and, second, to provide space heating. Its design incorporates several new features as follows:

1, It involves the first practical application of aluminum-clad fuel elements for a high temperature power producing reactor. 2, It uses a newly developed air-cooled condenser constructed completely of aluminum. 3, The plant uses gravel shielding to minimize the requirements for pouring concrete.

The ALPR system needs little attention; it automatically adjusts power to demand, and is rugged and simple. The prototype will be used to train personnel. Since the operators will be stationed in remote locations, safety was a key consideration in the design of the plant. Because a reactor refueling always entails exposing personnel to higher radioactivity than does normal operation, ALPR's long-lasting fuel charge is a decided asset.

An interesting feature of ALPR's design is that it has no vapor containment [illegible] since future models of the reacto[illegible] will be installed in remote areas, the containment shell common to other nuclear power stations is not considered necessary.

The boiling water itself has a high degree of inherent safety. If reactivity is increased in a boiling reactor by withdrawing a control rod, the rate of heat generation increases until the reactivity subtracted by steam bubbles exactly compensates for the reactivity added by withdrawal of the control rod. The negative reactivity

ATOMICS

effect of steam bubbles occurs because the nuclear chain reaction depends on the presence of water moderator in the core. As the water boils, steam bubbles (voids) force moderating water out from between the fuel plates and the voids provide an easier neutron leak path. This negative reactivity effect makes control of a boiling water reactor easier.

The fuel elements are aluminum-uranium alloy, clad with a special aluminum-nickel alloy X-8001. They are completely welded and tested to assure that no radioactive materials can escape and that no water can enter to corrode the fuel. This cladding constitutes the first defense against release of radioactive material.

The second defense is the completely sealed, closed-cycle coolant system that includes the reactor pressure vessel, piping, turbine, condenser, and storage tanks. This system can contain any radioactive material that might accidentally be released in case of a fuel element failure. Major catastrophes are highly unlikely with the ALPR reactor. Radioactivity released by minor accidents that could breach the first two defenses would be partially contained by a third defense — the tanklike building in which the reactor system is housed. Although the building is not completely sealed, it should inhibit the escape of radioactive material to the atmosphere.

Designed into the system is a series of detectors and circuits that will shut down the reactor automatically. Typical shutdown causes are: 1. Abnormally high power level, 2. Instrument voltage supply failure, 3. water level too high or low, 4. steam system pressure too high, 5. rate of increase of power too rapid, 6, loss of electric power supply, 7. reactor steam pressure too low, and 8. thermal shield temperature too high. As an added precaution some of the more vital circuits have standby duplicates.

Core elements will not be subject to a heat flux that will cause burnout because control rods can be inserted rapidly enough to shut down the reactor safely if the period becomes too short or if the power level becomes too high. Further secondary shutdown can be effected by injecting neutron-absorbing boric acid into the water.

The Reactor Building

The building that houses the Argonne Low Power Reactor is a circular, continuous-welded steel tank, 38 ft, 7 in. in diameter, extending 50 ft above grade. The bottom of the tank rests on concrete piers two feet above grade. This creates an air space that reduces the heat transfer into the ground below the tank which, at an Arctic installation on permafrost, must remain frozen. The tank serves as a weather shell around the structural steel framework that was erected inside of the tank and independent of it. The building has two floor levels: the operating floor is 19 ft, 4 in. and the fan floor 32 ft above the tank bottom.

The pressure vessel is centrally located below the operating floor. Here also are three fuel storage wells, a reactor water retention tank, a purification vault, two storage sumps, and various instrument wells, ducts and piping. All these components are embedded in gravel that serves as a radiobiological shield. The gravel fills the bottom of the tank to within two feet of the plant operating floor.

The operating floor is of ¼-in. steel plate. The top of the reactor is further covered with movable shielding. Between the operating floor and the fan floor are the turbine-generator, a 1000-gal water storage tank, control panels, two feedwater pumps, the hot well, a boron injection system, parts of the purification system, the overhead cranes and other equipment. Access to the building is by an enclosed stairway, an emergency open stairway, and a cargo door in the tank wall, all leading to the operating floor.

Access to the fan floor is through a hatch from below and an air lock. The floor contains the main air-cooled condenser with its fan, an air-mixing chamber, and ductwork. Condenser cooling air is supplied and exhausted through an opening in the tank wall. An equipment hatch can be opened in the metal panel floor.

The main control room is in the Support Facilities Building, which is connected to the reactor by a passageway and the enclosed stairway. The Support Facilities Building also houses, offices, shops, training facilities, and simulated loads for the generator and space heating systems. As indicated earlier, the ALPR building and reactor components can be transported by air.

The reactor vessel, built by Lasker Boiler Works of Chicago, Ill., is fabricated from Type SA-212, Grade B Firebox steel, ¾-in. thick, clad with 3/16-in. type 304 stainless steel.

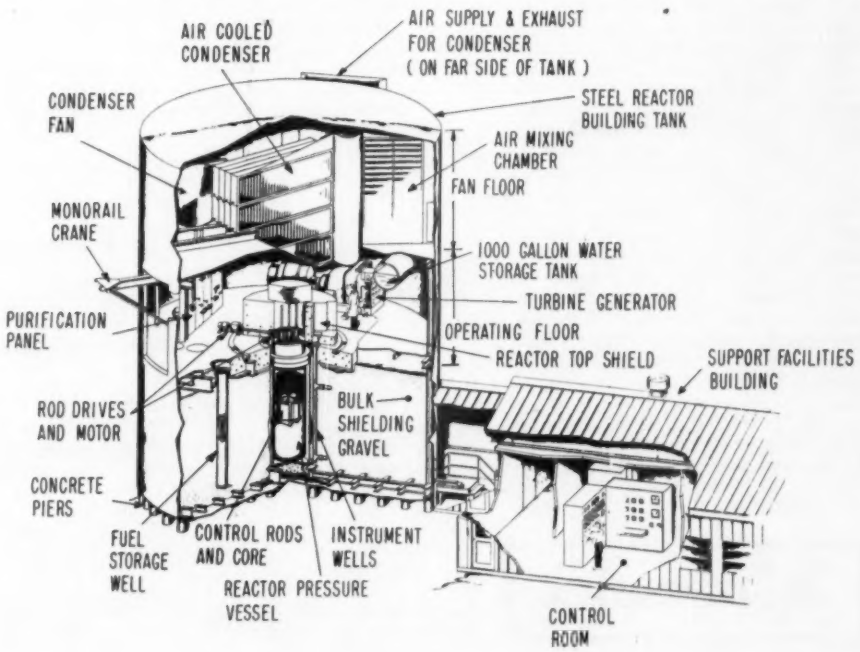


Fig. 2. A cut-away diagram of the Argonne Low Power Reactor, showing the reactor's location with the bulk gravel shielding surrounding it, and the turbine-generator and air-cooled condenser in the upper part of the reactor building

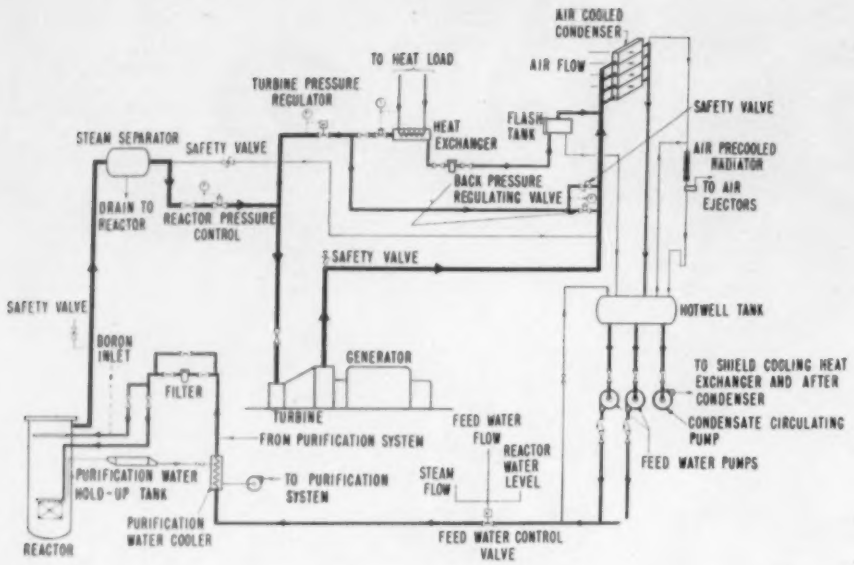


Fig. 3. This is a flow diagram of the ALPR system. Note the steam line to the heat exchanger for the heating load. This part of the system will supply 400 kw of heat

The cover plate is 8 in. thick and is also stainless-steel clad. The vessel measures 14½ ft between the inside surfaces of the top and bottom heads and 4 ft, 6 in. outside diameter. It was designed for 400 psig at 450 F, water-and-steam temperature with 500 F metal temperature. The bottom is elliptical; the top cover is flat.

The top cover plate has nine 6-in. nozzles to accommodate control rod drives and two smaller nozzles for water level indicating controls. The nozzles provide access to the core for loading and unloading without removing the head. The vessel is insulated with 3 in. of magnesia, surrounded by a protecting steel jacket. The entire vessel assembly is suspended by its top flange which rests on a support cylinder. The support cylinder, in addition to supporting the vessel, furnishes radiation shielding. It has a blanket of lead 1¼ in. thick around it; copper cooling coils embedded in the lead remove the gamma heat. The lead is contained in a ¼-in steel jacket. The entire support cylinder and vessel stand on structural steel at the bottom of the reactor building. In addition to the shielding already mentioned, the reactor and support cylinder are surrounded by gravel, which forms the main biological shield. Boral plates are used below the reactor. Steel shot and boric oxide are mixed with gravel and sand below and above the reactor.

Nuclear Design

ALPR operates at 300 psig and 420 F. Coolant flows by natural circulation up the coolant channels in the core and down through the region outside the core where it also serves as neutron reflector and shield. This circulating water mixes with cooler feedwater being returned to the vessel; therefore, water entering the coolant channels is slightly subcooled. Approximately one fourth of the heat generated in the core is required to raise the temperature of the coolant to saturation.

The design of the core was guided by three major considerations: First, in the light of favorable experimental work in BORAX I, II, and III, it was decided to use aluminum plate type fuel elements, assembled into roughly 4-in. by 4-in. boxes. The *meat* of the fuel plate is aluminum alloyed with highly enriched uranium. One significant improvement is that some nickel was added (2 per cent by weight) to increase the strength of the alloy to corrosion by boiling water.

A second consideration was that the volume fraction of all the metal in the core should not be so small as to lead to a positive steam void coefficient, nor so large as to lead to a large negative void coefficient, and to possible unstable reactor operation. A metal-to-water ratio equal to 0.5 was set as a goal for the cold reactor, this value being intermediate to the corresponding ratios in BORAX I and III. Subsequently a coolant channel width of 0.31 in. was selected as a resonable extrapolation from BORAX core design, together with a 0.050-in. meat thickness in the fuel plate. The reactivity controlled by the steam void is approximately 1.5 per cent in the fresh reference reactor operating at 3 mw(thermal).

The third major consideration governing the ALPR core design was that enough control should be available in the form of rods or plates to control the reactor at all times throughout the core cycle. Five cross shaped rods were selected for the reference core, and provisions were made for additional T-rods to be

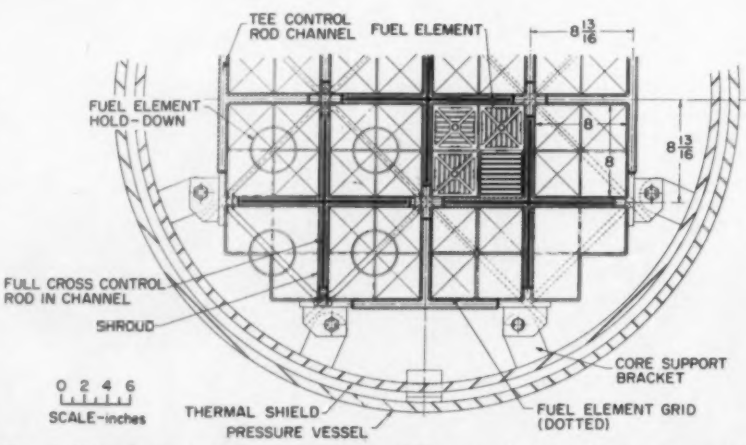


Fig. 4. Here is the arrangement of the ALPR core, showing the two types of control rods (cruciform) and (T-shaped) positioned in relation to the fuel elements

ATOMICS

added if the reactor should be loaded to its maximum capacity of 59 fuel assemblies. For safety reasons it was decided not to gang rod drives.

To reduce control rod requirements so that this control system would be adequate, consideration was given to the uniform dispersal of a burnable poison, boron-10, in the fuel meat. It proved difficult to fabricate well-bonded clad fuel plates incorporating a fixed amount of burnable poison. The choice fell instead to thin strips of aluminum-nickel alloy containing boron-10. These strips are welded to the side plates of the fuel assembly. It is anticipated that enough boron-10 will be incorporated to control approximately 10 per cent reactivity in the fresh reactor. The 15 per cent control capacity by 5 cross rods in the cold reference core is sufficient to manage the remaining reactivity variation during reactor operation.

First order perturbation theory has been applied to the investigation of reactivity effects of fuel burnup during reactor operation. The results of this study are presented in Fig. 5. After xenon has essentially reached equilibrium, the reactivity changes little during the first two years of core life, thus easing the problem of reactor control.

The reference core loading is now 14 kg of U 235 in 40 fuel assemblies. The number of assemblies may be revised in accordance with early experimental information in order to improve the neutron flux distribution and to provide enough reactivity for a core life of several years at average power, and to ensure stable reactor operation at maximum power. Enough reactivity will be available to permit override of maximum xenon during most of the core cycle.

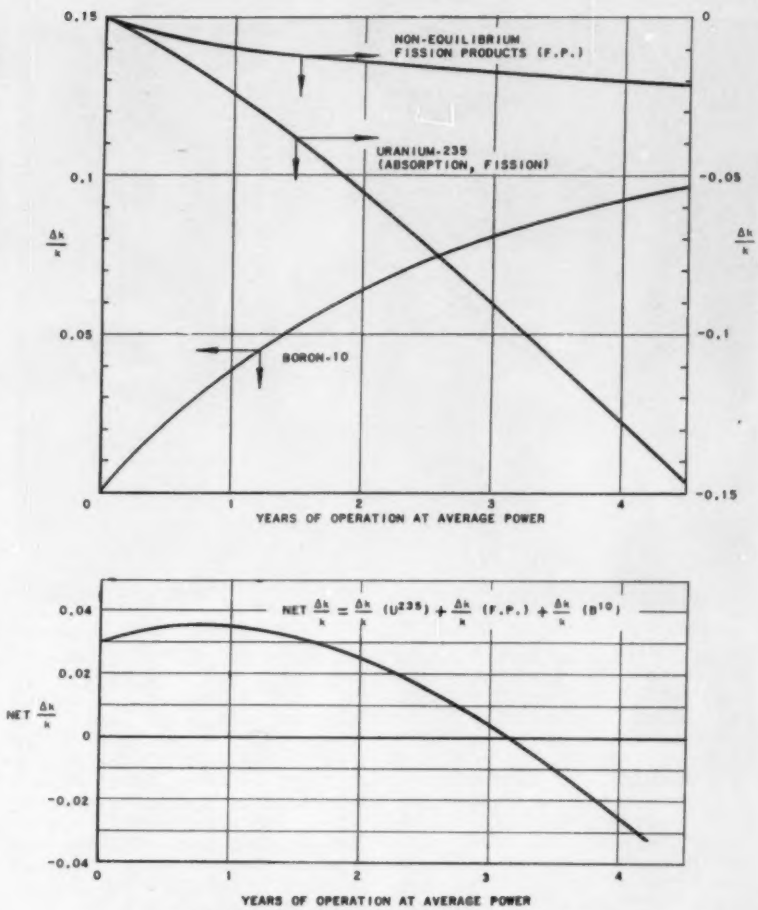

NON-EQUILIBRIUM FISSION PRODUCTS (F.P.)
URANIUM-235 (ABSORPTION, FISSION)
BORON-10
Δk/k
YEARS OF OPERATION AT AVERAGE POWER
NET Δk/k = Δk/k (U235) + Δk/k (F.P.) + Δk/k (B10)
NET Δk/k
YEARS OF OPERATION AT AVERAGE POWER

Fig. 5. Reactivity variation during core lifetime

Steam Cycle

Water level in the reactor is held constant in the pressure vessel by an integrating three-element control system to insure steady operation and complete immersion of the reactor core. This system regulates the feedwater flow to the reactor automatically by: (1) simultaneously measuring the water level, the steam flow, the feedwater flow; (2) integrating the electrical signals from the measurements; and (3) electrically adjusting the feedwater flow valve. Thus, under steady-state conditions, feedwater flow exactly equals steam flow.

Feedwater enters the reactor through a spray ring surrounding the core, flows down the circular annulus around the core, and mixes with the downcoming water, making it slightly cooler than the rest of the core. This phenomenon, plus the lighter weight of the coolant in the steam-filled channels within the core, causes natural circulation of the water upward through the core. For every pound of steam produced, roughly 120 pounds of water are circulated through the reactor. The ALPR generates steam at a rate of 9020 lb per hr, corresponding to a reactor heat output, at full capacity, of slightly less than 3000 kw.

All returned feedwater is filtered; otherwise irradiated corrosion products carried over by the steam might contaminate the conventional external system. Five gallons of water per minute are continually circulated through a purification system to maintain high purity.

About 85 per cent of the steam produced in the nuclear reactor is fed into a conventional steam turbine, coupled to a 300-kw electrical generator. Steam enters the turbine at 275 psi and somewhat less than 420 F, and is exhausted to the air-cooled condenser at a vacuum corresponding to 4.85 in. of mercury.

The steam condenser for the ALPR system is cooled by air instead of water used in most conventional plants. The air is circulated over finned condenser tubes by a 90-in. fluid-drive, 75 hp fan delivering an estimated 93,000 cu ft per min.

Fifteen per cent of the steam produced in the reactor is available for space heating. In the prototype reactor the heat is dissipated through a hot water-to-air heat exchanger but in an actual installation, the heat would be used in a conventional radiator system using hot water or steam.

All critical experiments and checkout of components were performed in the reactor itself. Initial criticality was achieved on August 11, 1958 using 10 fuel elements containing a total of 3.5 kg of uranium 235 without boron strips attached. Eventually the initial reference loading of 40 elements was reached with one 26-millboron strip attached to one side plate of each fuel element. The worth of the strips was measured by substitution and removal experiments in six different core locations. Next, the maximum safe reactor concentration of soluble poison was determined for later use in rod calibration experiments. This concentration was obtained to satisfy the condition that void-generating accidental nuclear excursions in the cold reactor would be self-limiting. That is, the generation of voids in the region of highest neutron flux would shut down the reactor in spite of the positive reactivity effect of the expulsion of soluble poison.

Spaces for 19 additional fuel ele-

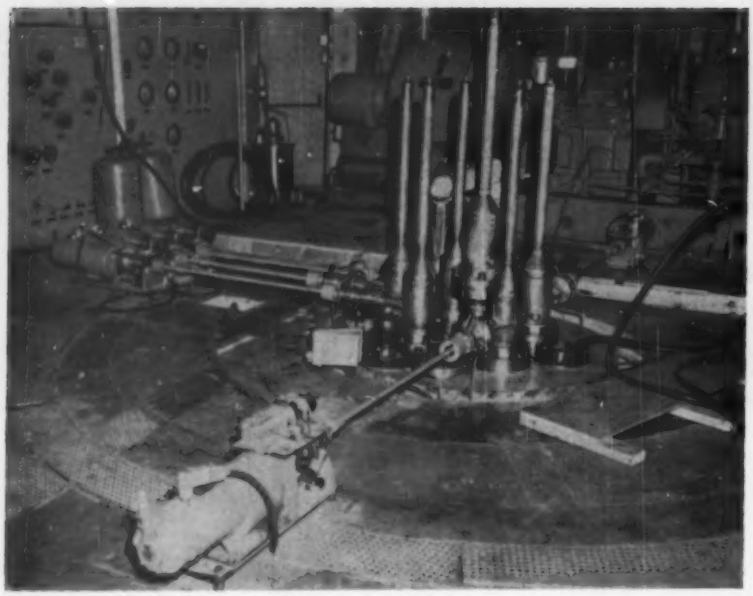


Fig. 6. ALPR control rod drives and motors; shielding removed on the operating floor

ments and spaces for four additional control rods (T-shaped) were provided in the reactor design. Nineteen fuel elements were added to fill the remaining spaces; one 21 mill thick boron strip was attached to each of these elements. The differential and integral worths of the bank of nine control rods were obtained as a function of rod penetration of the core. The rod penetration for criticality was varied by controlling the concentration of boric acid in the reactor water. Differential rod worths were obtained from measurements of the positive periods resulting from incremental rod withdrawal of the nine control rods. Eventually sufficient boric acid was added to the reactor water to permit complete withdrawal of the nine control rods. Then fuel elements were removed until the initial reference 40-element loading again was attained. Next, with successive incremental dilutions of the boric acid solution, the calibration curve of five cross control rods was obtained in a similar manner.

At this point sufficient information was available to permit the tentative selection of the final 40-element boron loading. The only revision was to add a one-half length 21-mill boron strip to the other side plate of each of the central 16 fuel elements so that in the fresh operating reactor the five control rods would be controlling only 2 to 3 per cent reactivity. Using boric acid again, calibration curves were obtained for the five cross rods in the final 40-element core. Then the concentration of boric acid in the water was adjusted so that the critical position of the control rods was approximately that estimated for the hot (420F) fresh reactor containing full-power equilibrium xenon. With this rod configuration a more accurate measurement was made of the worths of 26-mill and 21-mill boron strips in various radial locations of the core. During the experimental program just described, boron strips has been taped to the side plates of the fuel elements. In order to ensure that the strips would remain in position during the following hot, pressurized experiments, the tape was removed, the elements cleaned, and then the strips were welded to the side plates.

After preparations for the hot pressurized experiments were completed, critical experiments were performed at various temperatures up to 420 F. The reactivity effect of the rise to operating temperature was measured, and a flux plot was made by irradiating gold wires in the hot 40-element core. Enough boric acid had been added to permit the withdrawal of the control rods approximately to the estimated operating position of the five-rod bank in the hot fresh reactor. In order to avoid making the fuel elements quite radioactive and therefore difficult to handle during the remaining pre-power work, a gas-fired steam boiler was used to heat the reactor water.

After a revised loading was selected, and using the heat supplied by the steam boiler, the temperature of the reactor water was increased incrementally to operating temperature. The boric acid concentration was adjusted to obtain its critical concentration as a function of temperature; the position of the five-rod bank was held within a small variation around the position estimated for the hot fresh reactor containing (3 mw) equilibrium xenon. A flux plot was made in the hot 59-element reactor by irradiating copper wires.

The steam coils were removed and the plant prepared for nuclear power operation. Nickel wires containing approximately 0.6 per cent cobalt were positioned in the fuel elements of one quadrant of the 40-element core in the expectation that a flux plot would be made in the reactor operating at 3 mw. The 40-element core was reinserted in the vessel, and the pressure vessel was *buttoned up*. On October 23, 1958, the reactor was brought to cold criticality and the neutron flux level was raised to bring the system to operating temperature and pressure with nuclear heat. At 8:06 am, October 24, ALPR was operated at 300-kw of electricity produced in the generator and a heat load of 400 kw. THE END

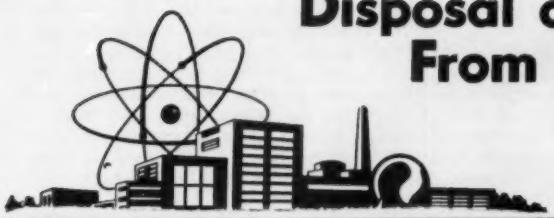
REPRINTS OF ATOMICS

Reprints of the ATOMICS sections from POWER ENGINEERING for the six months from January to June 1959 will be available about the middle of July, 1959. Only enough of these will be printed, however, to take care of advance orders. They will be available at $1.00 per copy. If you want one of these reprints, please fill in the following form, and send it to:

Editor, ATOMICS
c/o POWER ENGINEERING
308 E. James Street, Barrington, Illinois

☐ Enclosed is my $1. Please send me the reprint when ready without further bother on my part.
☐ Tell me when my copy is ready and I'll send you the $1 then.

Disposal of Radioactive Wastes From Nuclear Power Plants



ONE OF THE pressing problems of the potential nuclear power industry is the necessity for disposing of radioactive wastes incident to operating reactors and recovering fissionable material from expended fuel elements. This is no small problem and is one which is bound to grow in importance as the atomic power industry develops in the years to come. When it is realized that the radiation from the waste of a single atomic power reactor is equal to that of hundreds of tons of radium the seriousness of the problem needs little further emphasis.

The general considerations pertinent to the disposal of radioactive wastes by various methods have been discussed by numerous people connected with the industry, and at such large establishments as the plutonium production plant at Hanford the problem has been dealt with on a large scale. But Hanford is a unique establishment and the problems there are likely to be different from those which will be encountered in nuclear power plants. The original method of storing wastes in large tanks, as at Hanford, although still being used is considered only an interim measure. Ultimate disposal methods now being studied show encouraging promise. These include deposition into salt domes and deep wells, fixation in unleachable ceramics for ocean or land burial, and self-sintering in unpermeable surface pits.

The seriousness of the radioactive waste disposal problem can be illustrated by considering the operation of a single large nuclear power plant, say, a plant having an output of 500,000 kw, the size of Hinckley Point Station now under construction in England. The uranium fuel burnup of such a plant would be around 1000 lb, or one-half ton, per year. This means the production of 1000 lb of fission products per year, and this must be disposed of.

If we assume continuous operation of the plant for a year, then the uranium *ashes* one day after removal would contain radioactivity equal to that emitted by 1000 *tons* of radium. A year later this radioactive waste product would have dwindled 25 tons of radium-equivalent activity, and it would take 5 years more for this value to drop to 5 tons radium-equivalent. In considering these figures, it may be of interest to point out that in all the years since the Curies' isolated radium, in 1902, less than four pounds of radium have been isolated. To provide any substantial fraction of electric power for the United States in the future, there would have to be scores of such nuclear plants, and the radioactive wastes would have to be numbered in many thousands of tons of radium-equivalent.

Thus, the long term, safe disposal of such fantastic amounts of radioactivity is a national and international problem of staggering magnitude. It is a public health problem which will be with us for centuries to come, and unless every effort is made now to develop methods for disposing of these wastes in the future, nuclear power may present hazards far outweighing its value as an energy source. It is obvious, therefore, why the Atomic Energy Commission is sponsoring intensive research aimed at finding techniques for solving the waste disposal problem.

Waste Disposal Economics

To a large extent, of course, the waste disposal problem is an economic one because unless low cost methods of storing wastes can be developed, nuclear power will have little chance of competing with conventional power on a commercial basis. One of the difficulties in making studies of waste disposal lies in estimates that have to be made of the cost of facilities that will have to be provided many years in the future — up to 400 years. In a recent study by L. R. Bacon and W. J. George of Wyandotte Chemical Corporation, they applied the concept of *present worth* in determining the charge that should be made today to cover the cost of waste management over the hazardous life of the materials. In these studies they assumed an optimum initial storage period of 10 years prior to removing the material from tanks and shipping it to a final disposal site. Previous studies by others had assumed a 7 year initial storage period. For a storage cost of $0.041 per gal per yr and a 500-mile shipping distance, the optimum storage period is shown to be 10 years. For the lowest storage cost ($0.013 per gal per yr) the optimum initial storage periods are 20 years for transportation distances up to 200 miles and greater than 30 years for distances of 500 to 1000 miles.

Present worth concepts have also been applied to the determination of the total cost of liquid waste disposal using tanks and salt cavity storage. It has been reported that 1 to 10 per cent of the total cost of power might be allocated to waste treatment and disposal. This would be 0.08 to 0.8 mills per kwh for 8 mills per kwh nuclear power.

A previous estimate by F. L. Culler, Jr, indicated that the total cost for 400-year storage, including a 500-mile transportation charge of $0.82 per gal, would be $4.09 per gal and $18.09 per gal (0.14 and 0.60 mills per kwh) for tanks costing $0.25 and $2.00 per gal, respectively. The use of present worth concepts to determine the proper sum to charge today indicates that this charge, excluding transportation charges would be $0.27 per gal and $1.44 per gal for $0.25 and $2.00 per gal tanks (0.009 and 0.048 mills per kwh.) These charges do not include any profit or interest charge on the use of capital. Culler's results represent the total amounts of money that will be required over the 400-year life of the waste solutions. The results reported by Bacon and George represent the present worth of the total funds required or the money which must be set aside today to pay these future costs assuming the time value of the money is 3 per cent compounded semiannually.

In these studies, the life of the tanks involved was assumed to be 50 years. This means that new tanks would have to be provided every 50 years and means provided to pump the radioactive liquids from the old tanks into the new tanks. The charge that must be made (present worth) for salt cavity storage for untreated liquid waste solutions for the 400-year storage period is $0.11 per gal, based upon the same assumptions as used for tank storage with salt cavity costs in the range of $1 to $4 per bbl, excluding transportation charges. This corresponds to 0.004 mills per kwh without profit or interest on capital.

Salt Cavity Storage

The economics of a combined tank-salt-cavity storage system have also been examined. For a 10-yr initial tank storage and 500 mile shipment to the final salt cavity disposal, the charges that must be made to cover the future costs are $0.75 per gal and

$1.22 per gal for tanks costing $0.25 per gal and $2.00 per gal, respectively, and salt cavities that cost $1.00 per bbl (0.025 and 0.041 mills per kwh) excluding interest or profit on the required investment.

The method of injecting radioactive solutions of waste fission products into porous and permeable sedimentary rock formations is interesting and may offer a solution to the long range problem. The Bureau of Mines has made a detailed analysis of the feasibility of doing this in areas where the geology permits this method of disposal. In addition to geological considerations, the geography and economics of any disposal system are governing factors.

A parallel to potential radioactive waste disposal exists in the current practice of the oil industry in disposing of millions of gallons of oilfield brines daily. Although brine injection is much simpler than would be the injection of radioactive wastes, preliminary investigation into this method of disposing fission product waste appears promising. An analysis of the current costs of drilling wells to different depths for exploration, injection, and monitoring indicates that the economics of injecting radioactive wastes into comparatively shallow formations, if otherwise practicable, is favorable.

A study of comparatively shallow and stratigraphically isolated sandstone lenses and *shoestrings* common to midcontinent United States and some other areas of the country shows that such formations might be adaptable at least for pilot tests of the feasibility of radioactive waste injection and perhaps for actual disposal. Much geological, engineering, and chemical information now is available about such rock formations that have been proved to be productive of petroleum and have been repressurized with fluids to stimulate oil production.

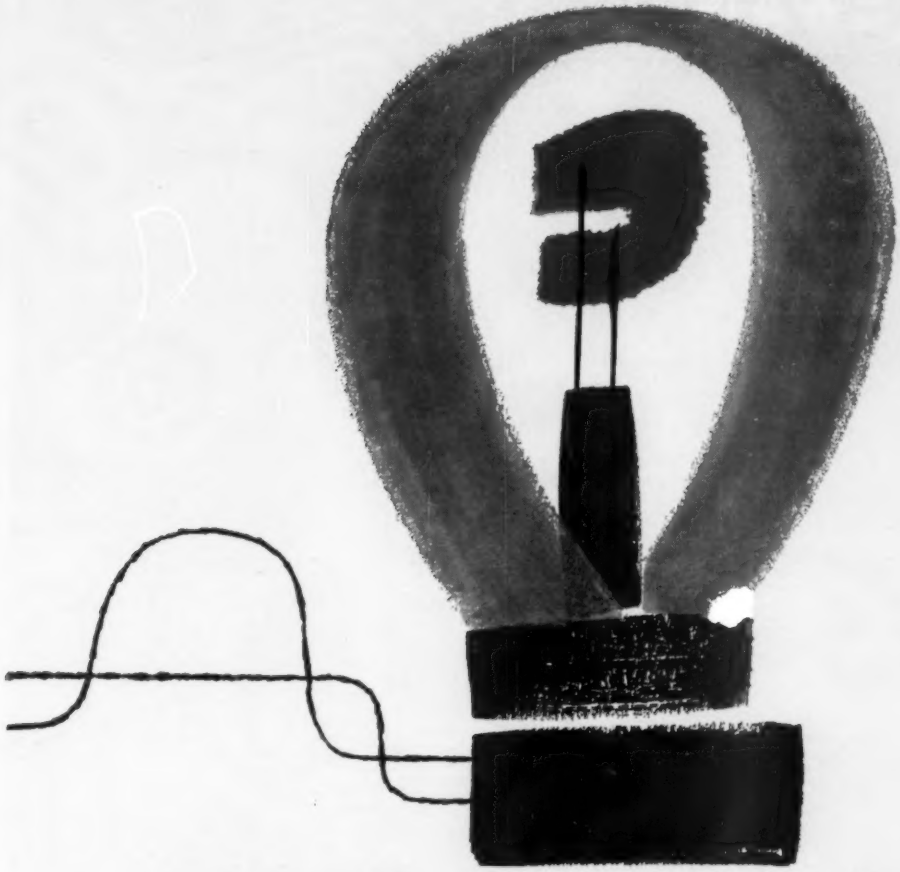
Laboratory research problems pertinent to the disposal of radioactive wastes by injection include ion exchange and adsorption of fission products, chemical and physical reactions between injected wastes and disposal reservoir solids and fluids, corrosion by waste materials, corrosion resistance of special metallic alloys, injectivity, and horizontal and vertical migration of injected radioactive wastes.

In a paper recently presented at the American Nuclear Society meeting in Detroit, Watkins, Armstrong, and Heemstra all of the Bureau of Mines, described a hypothetical example of a pilot plant for secondary treatment and injection of dilute fission products into a shallow, lenticular sandstone formation with well-defined boundary conditions. A sandstone body 1.5 miles long and 0.5 mile wide, with an average effective thickness of 30 ft and an average porosity of 25 per cent, with suitable allowances for irreducible water content and heterogeneity, would have a theoretical storage capacity of 3.8 x 10^8 gal. various estimates of the accumulated volume of high activity wastes in the United States by the year 2000, based on predicted nuclear power economy and various assumptions, range from 2 x 10^8 to 10^9 gal. Even with the high dilution factor that may be required to combat problems of injectivity, heat, and radioactivity, the capacity of a small reservoir should be adequate to receive much of the waste from one potential nuclear fuels processing plant. Although several processing plants might be required in different areas of the United States, one plant presumably could process fuel elements from several reactors. THE END

New Nuclear Literature

Among the recent publications issued by the AEC's Technical Information Service Extension at Oak Ridge, Tenn, a new series, known as the Translation Series, includes several volumes translated from Russian technology. One of these (AEC-tr-3405) should be of particular interest to those in the United States who are engaged in the design of pressurized or boiling water reactors, since it consists of a number of papers discussing *"Problems of heat transfer during a change of state"*. This is a translation from a publication of the Soviet State Power Press. Research on heat transfer during a change of state of the heat carrier is a peculiar problem, the great complexity of which is due to the fact that in this case the substance exists simultaneously in at least two phases, at the boundaries of which the latent heat of phase transformation is either evolved or absorbed. Up to the present time far from enough research has been done on the processes involved in the boiling of a liquid, the condensation of vapor, fusion, and solidification, which are the foundations of a number of major branches of industry. During the past 15 years substantial success has been achieved in the generalized analysis of processes of this nature. As a result, a number of problems of practical importance have been resolved, and the theory of heat transfer during a change of state has become an independent branch of the general science of heat transfer. As pointed out in this Russian publication, Soviet science has played an important part in this branch of physical heat engineering. In particular, a large amount of new experimental data on extraction of heat during a change of state has been secured in recent years. Some of this material is presented in this volume, based on work done in various scientific research organizations. The papers included in the series are divided into three groups; The first group deals with problems of heat transfer in the condensers of steam prime movers and refrigeration machinery. The second group reports experimental data on the output of heat during boiling, especially in high-intensity processes. Finally, the last group of papers relate to the important problems of rates of accumulation and melting of ice as functions of the condition of heat transfer between the solid and liquid phases. Notwithstanding the fact that the papers in this symposium are based on research done in different scientific research institutions, the nature of the problems considered is what they have in common and how they mutually complement each other. This volume is available from the Office of Technical Services, Department of Commerce, Washington 25, D. C. at $2.50. * * * Another volume in this series of translations from the Russian is AEC-tr-3352, entitled *"Theory of Stability of Motion"* by I. G. Malkin. This is an extremely theoretical treatise on the stability of motion. The theory of the stability of motion is concerned with the effect of disturbing factors on the motion of a material system. By this is meant the factors which are not taken into account in describing the motion because they are quite small compared with the principal forces. These forces are usually unknown. They may act momentarily to cause a minor change in the initial state of the material system, that is, the initial values of coordinates and velocities, or they may act continuously which will mean that the assumed differential equations of motion are different from the true equations, and that certain small corrective terms are not taken into account. For certain motions the disturbing factors have little effect while in others their effect is significant so that the disturbed motion differs considerably from the undisturbed motion regardless of how small the disturbing forces may be. The theory of stability of motion then is concerned with determination of indications which permit us to judge whether the motion under consideration is stable or unstable. AEC-tr-3352 also is available from the Office of Technical Service, Dept. of Commerce in Washington. $4.75.

call KE for plant expansion or new facilities



INGENUITY

has made KE a major builder of dependable power facilities

100,000 kw steam power plant now under construction at Josephtown, Penn., for St. Joseph Lead Company, a large American lead and zinc producer. The new turbo-generator plant is being designed and built by KE's thermal power plant specialists.

Since installation, no unscheduled outages have occurred in power plants built by Kaiser Engineers. On the contrary, in numerous cases KE-built plants have fed power into neighboring systems temporarily "down."

Preventing outages, building in reliability that insures against service interruption—these are benefits of engineering and construction ingenuity as surely as are low initial cost, fast completion, and low operating cost.

Experienced KE engineers can take your power plant idea from conversation through completion; conduct every phase from economic analysis through operator training. Whether your future power needs are thermal or nuclear, call KE.

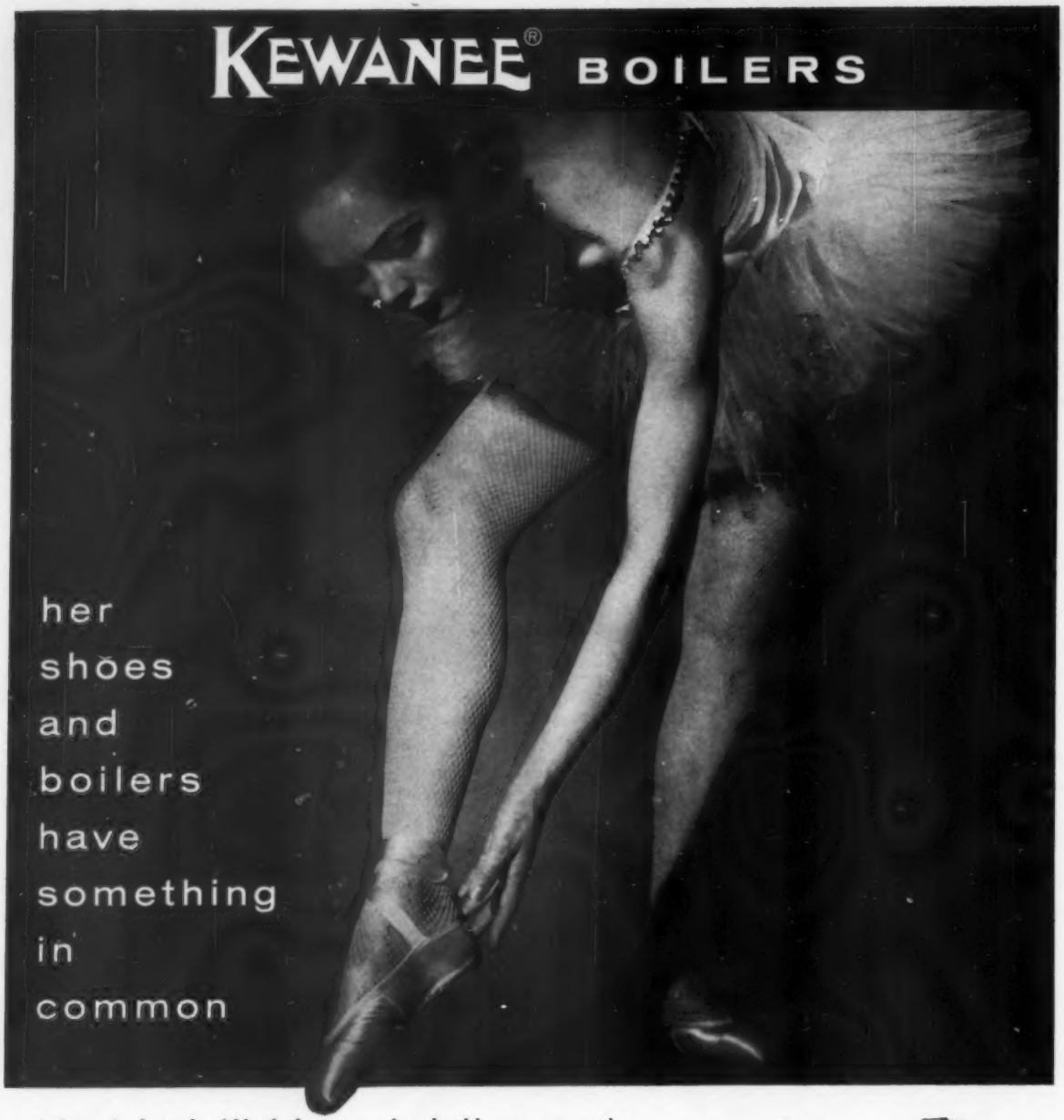
KAISER ENGINEERS engineers—contractors
Contracting since 1914

Division of Henry J. Kaiser Company • Oakland 12, California • New York, Pittsburgh, Washington, D.C., Buenos Aires, Calcutta, Dusseldorf, Montreal, Rio de Janeiro, Sydney, Tokyo

4384

For more data circle 532 on Post Card

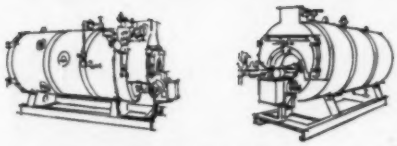
KEWANEE® BOILERS



A dancer's shoes should be the best . . . and so should your company's boilers.

Because so much depends on them, Kewanee Boilers are built to be the best—for capacity, safety and dependability. The fact that they also cost less to operate is an extra bonus. When you need more heat, power or process steam consider the advantages of Kewanee Boilers—now available in a full range of forced-draft packages. AMERICAN-STANDARD*, INDUSTRIAL DIVISION, Detroit 32, Michigan.

*American-Standard and Standard ® are trademarks of American Radiator & Standard Sanitary Corporation.



NEW 18-651 hp KEWANEE PACKAGES! Just announced, these new scotch type units are available high pressure or low pressure, for oil, gas or combination oil-gas. Write for literature and catalog sheets.

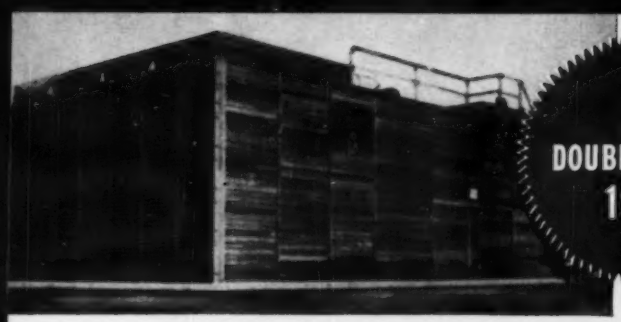
AMERICAN-Standard PRODUCTS

AMERICAN-Standard

INDUSTRIAL DIVISION

AMERICAN BLOWER PRODUCTS • KEWANEE PRODUCTS • ROSS PRODUCTS

For more data circle 533 on Post Card



First DOUBLE-FLOW 1938

20 Years and 2000 Double-Flows later

Marley Class 600 Double-Flows®

again revolutionize water cooling!

Once again, Marley introduces a tower so new in design and unprecedented in performance that it signals another 7-league stride in industrial water cooling. It is the new Marley Class 600 Double-Flow, successor to the original Double-Flow that has been, by any standard of measurement, America's Number One Industrial Cooling Tower since its introduction in 1938.

Since that time, as evidenced by 2000 Double-Flows in service, Marley's leadership in industrial cooling tower design has never been challenged, for Marley has constantly improved every functional and structural element, all to further its goal of "moving more air to cool more water efficiently". Such improvement is everywhere apparent in the new Class 600 that offers new economies in basin cost and power usage . . . lower draft loss . . . more uninhibited air flow . . . longer service life . . . no splash-out or icing . . . increased cooling capacity in every frame size!

The Class 600 Double-Flow represents technological advances of major importance to everyone in industry concerned with water cooling and conservation. These advantages and complete data on design and components are detailed in a new 20-page booklet — Bulletin CF-59.

Ask the Marley Engineer in your city for a copy of CF-59 — or write today.

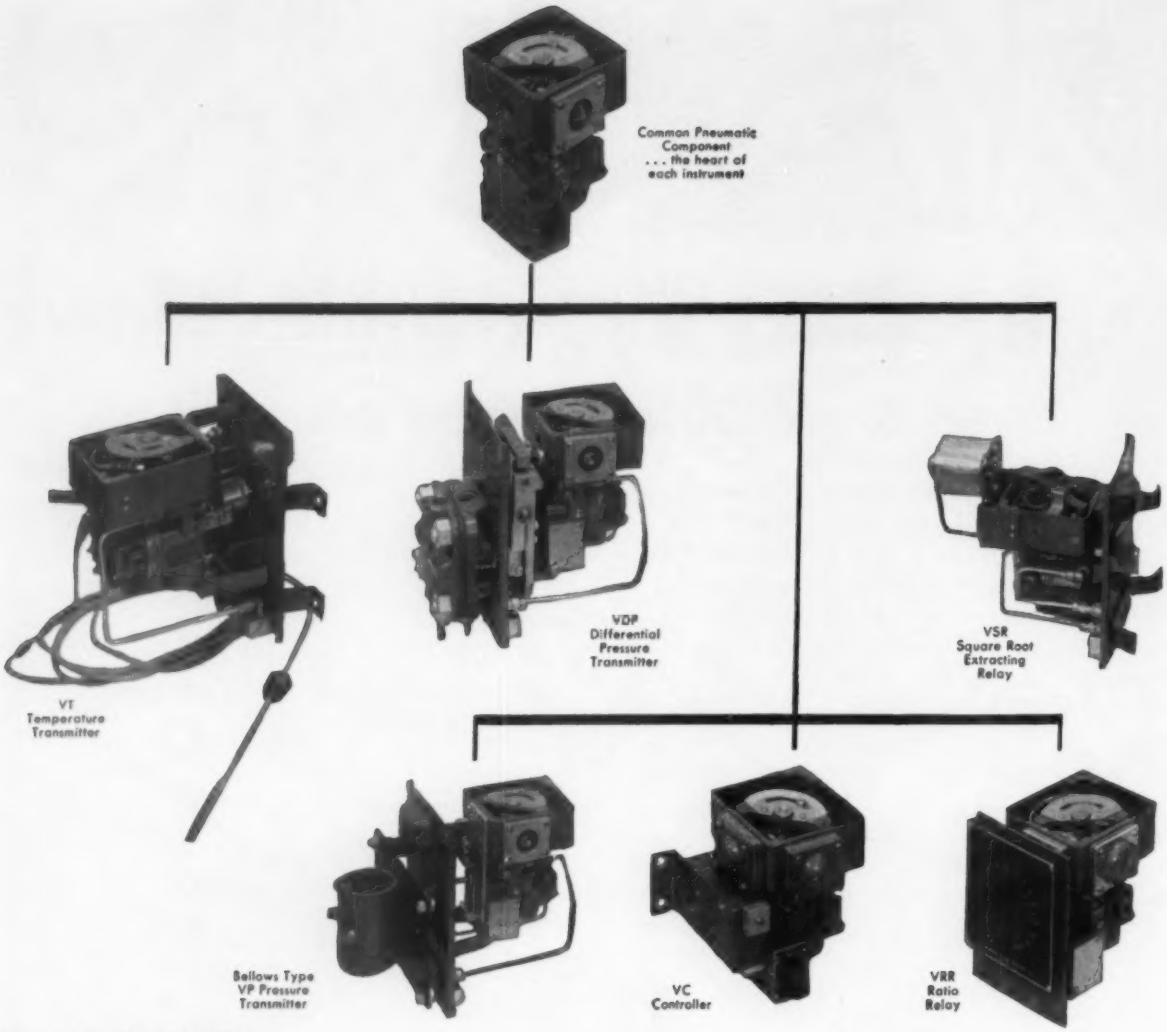
Marley equipment and components covered by U. S. and Foreign Patents and Patents Pending

First CLASS 600 DOUBLE-FLOW 1958

MARLEY

The Marley Company

Kansas City, Missouri


Common Pneumatic Component ... the heart of each instrument
VT Temperature Transmitter
VDP Differential Pressure Transmitter
VSR Square Root Extracting Relay
Bellows Type VP Pressure Transmitter
VC Controller
VRR Ratio Relay

Rockwell-Built

Republic Vector Series Instruments

serve any process, cut costs too!

You can save substantial money when your control systems are based on Republic's Null-Balance Vector instruments. Each has as its "heart" an identical pneumatic component, with obvious advantages. Among these are interchange of parts, even among instruments performing entirely different functions. Besides involving a minimum spare parts inventory, this feature greatly simplifies personnel training.

Components shown demonstrate the depth of the Republic line. Differential pressure transmitters with 20-to-1 range adjustment . . . temperature transmitters with 10-to-1 range adjustment... pressure transmitters of ±.5% accuracy. We have ratio, totalizing, multiplying, squaring and square root extracting relays. Our all-purpose controllers feature proportional band adjustment of 2% to 500% and reset adjustment from 0.1 to 50 repeats per minute.

The Republic Engineer in your area will be glad to work with you on any control or measurement problem. Sales offices in principal cities throughout the United States and Canada. Call or write—with no obligation, of course.

REPUBLIC FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
2240 DIVERSEY PARKWAY CHICAGO 47, ILLINOIS
In Canada: Republic Flow Meters Canada, Ltd.—Toronto
Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.

For more data circle 535 on Post Card

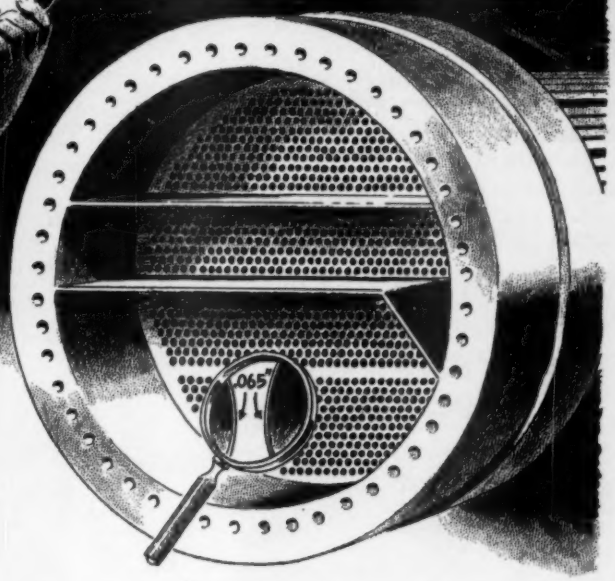
A "stitch-in-time" (Monel) once saved Miss Liberty

IN 1938 MISS LIBERTY WAS DANGEROUSLY CLOSE TO FALLING APART AT THE SEAMS. CORROSIVE ATTACK BY SALT AIR AND INDUSTRIAL FUMES HAD WEAKENED AND LOOSENED RIVETS HOLDING THE STATUE'S HUGE METAL PLATES TOGETHER. BUT SHE WAS SAVED BY 65,000 MONEL* NICKEL-COPPER ALLOY SELF-TAPPING SCREWS WHICH PULLED THE PLATES UP TIGHT. THESE STRONG, CORROSION-RESISTING "STITCHES" STILL LOOK GOOD TODAY—20 YEARS LATER.

Inconel "X" Spring starves "hungry" water...

Withstands corrosive bite of 13,000 tons per hour, at 600°F

13,000 TONS PER HOUR OF HIGH-PURITY WATER AT 500-600°F FLOW THROUGH THE CORE MOUNT SPRINGS OF A NUCLEAR POWER REACTOR. TO PREVENT STRESS-CORROSION CRACKING OR EMBRITTLEMENT, THE DESIGNERS CALLED FOR INCONEL* "X"* AGE-HARDENABLE NICKEL-CHROMIUM ALLOY. SPRINGS MADE OF THIS ALLOY RESIST CORROSION AND RELAXATION AT HIGH TEMPERATURES—UP TO 1100°F IN SOME CASES!



Thin-wall 4300psi heater tubes—5/8" O.D.

THESE ARE THE FACTS ON THE MONEL ALLOY U-TUBES IN FINAL STAGE FEEDWATER HEATERS, NOW AT A NEW OHIO POWER STATION. THEIR 85-FOOT LENGTH MAKES THEM THE LONGEST MONEL ALLOY TUBES EVER MADE. ALTHOUGH THESE TUBES ARE DESIGNED TO WITHSTAND A WATER PRESSURE OF 4300 PSI, THEY'RE ATTACHED TO THE TUBE SHEETS BY ROLLING ONLY! QUITE A TRIBUTE TO STRENGTH AND DUCTILITY OF MONEL ALLOY.

Need help on a metal problem?

THERE'S A GOOD CHANCE THAT INCO'S MECHANICAL ENGINEERING SECTION HAS ALREADY SOLVED A PROBLEM SIMILAR TO YOURS. WHY NOT CONTACT THEM RIGHT AWAY FOR ASSISTANCE? JUST LET US KNOW THE DETAILS.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street — New York 5, N. Y.

INCO

*Registered trademark

INCO NICKEL ALLOYS

For more data circle 536 on Post Card

Built with stainless-clad steel

NEW BUNKER NOSES STAY NEW

This sample was cut from a plate of Lukens stainless-clad steel that had handled coal for 9½ years in a leading eastern utility. It not only stayed new but sliding coal actually polished its surface, kept it smooth. Costly hang-ups were cut to a minimum.

Lukens clad steel is not a lining but a solid plate—one side corrosion resistant stainless steel permanently bonded over all to a rugged backing steel. Not only in bunker noses, but in hoppers, chutes and spreaders, too, clad steel assures ready fabrication, easy modification, reduced maintenance and freedom from down time.

Bulletin 740 will give you performance facts and production information. Send in the coupon, and, if you wish, write for the names of experienced coal handling equipment builders. Lukens Steel Company, Coatesville, Pennsylvania.

LUKENS®

Helping industry choose steels that fit the job

SEND FOR THIS BOOKLET TODAY!

Manager, Marketing Service
LUKENS STEEL COMPANY
137 Lukens Building, Coatesville, Pa.

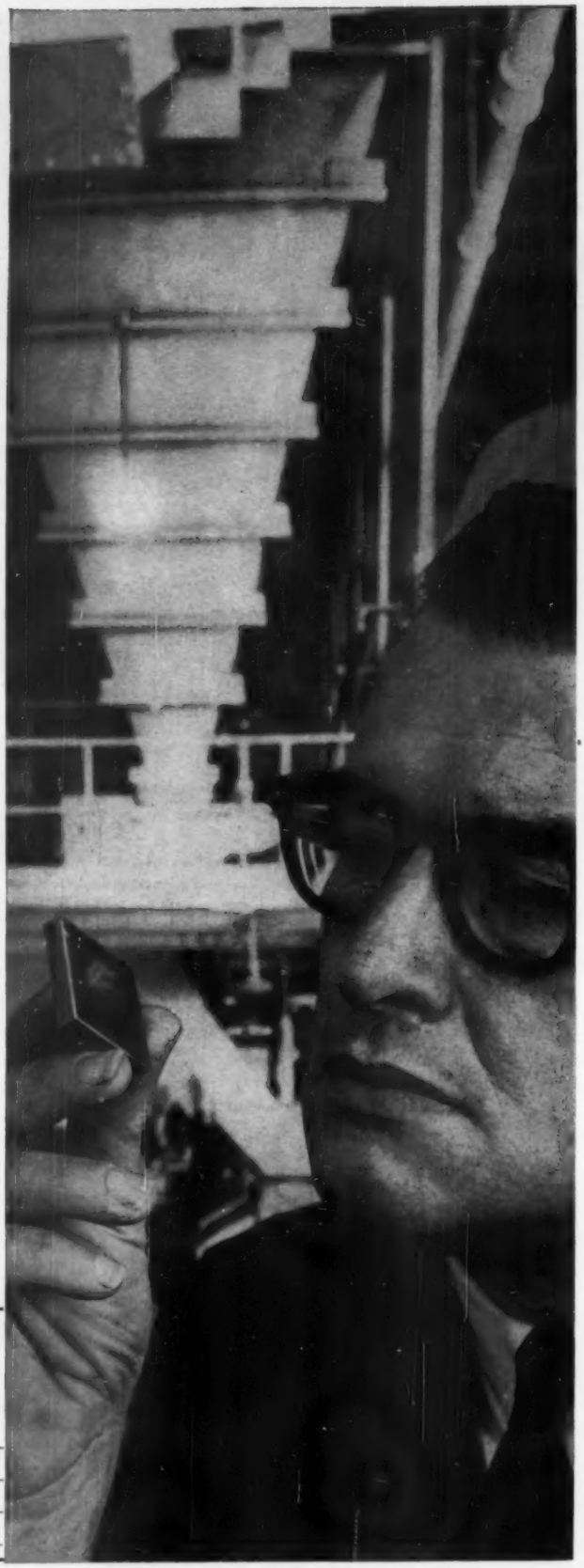
Please send me a free copy of your 16-page booklet, "Stainless-Clad Steel for Coal Handling."

NAME _____ TITLE _____

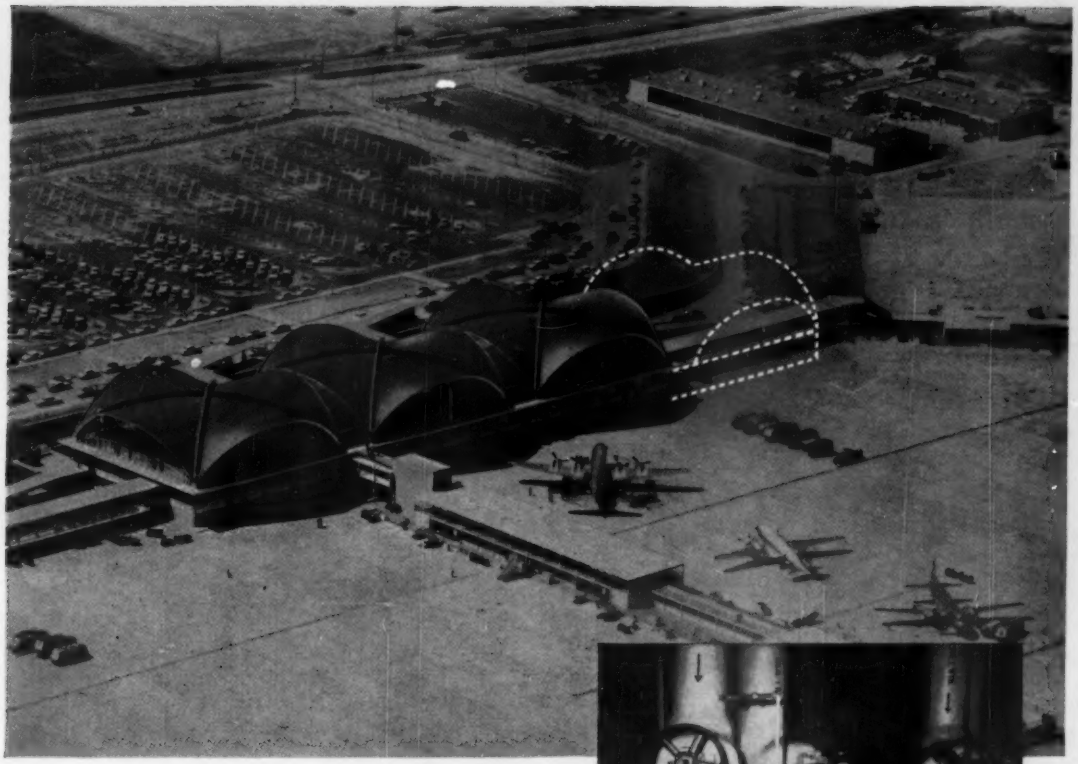
COMPANY _____

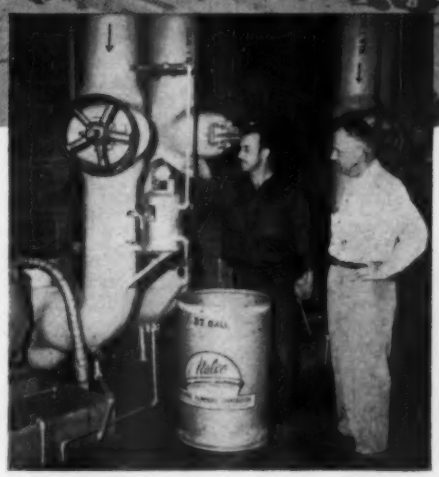
STREET ADDRESS _____

CITY _____ ZONE _____ STATE _____



For more data circle 537 on Post Card





Nalco protects vital services of new

LAMBERT-ST. LOUIS AIRPORT

Functional efficiency is usually one of the hallmarks of fine architecture and it is apparent throughout the new St. Louis Municipal Airport Terminal Buildings.

Vital service facilities are housed in a low, clean-lined power plant, well separated from the present main terminal building in anticipation of planned expansion to accommodate increasing airline traffic. The Nalco System protects boiler and cooling water systems by effectively controlling scale, corrosion and microbiological growth . . . a non-architectural supplement to functional efficiency in *any* plant where water is used.

Whether you are planning a new plant, or modernizing an old one, call on Nalco for water treatment chemicals and services that consistently produce outstanding results.

Top photo: Unusual modern architecture of St. Louis Municipal Airport Terminal Building is expandable in any direction. New units (dotted lines), can be added readily when required. Services buildings, *upper right*, are built and equipped with future expansion in mind. *Photo by Lloyd Spainhower.*

Lower photo: Nalco Chemicals and Services protect both boiler and cooling water systems at new St. Louis Airport. In this photo a Nalco cooling water treatment, supplied in ball briquette form, is being applied through the convenient Nalco feeder.

NATIONAL ALUMINATE CORPORATION

6224 West 66th Place • Chicago 38, Illinois

CANADA: Alchem Limited, Burlington, Ontario
NORTHWESTERN UNITED STATES, HAWAII and ALASKA:
The Flox Company, Inc., Minneapolis 3, Minnesota
ITALY: Nalco Italiana, S.p.A.
WEST GERMANY: Deutsche Nalco-Chemie GmbH
SPAIN: Nalco Espanola, S.A.

THE Nalco® SYSTEM . . . *Serving Industry through Practical Applied Science*

Nalco CHEMICALS

For more data circle 538 on Post Card

Hagan Dust Collector Tube shows

no erosion

after collecting 160 tons of slag dust

The collector tube shown here was cut from a 184 tube Hagan Aerostatic Dust Collector installed on a blast furnace slag dryer at the Neville Island Plant of the Pittsburgh Coke and Chemical Company. The collector has been in operation for more than two years, collecting slag dust at the rate of 23,400 tons per year.

The dust loading from the slag dryer is about 25 grains per cu. ft., almost ten times the loading from the average coal fired boiler and many times more abrasive. During its two years of operation, the Hagan collector has been consistently operating at 93% efficiency, despite the extremely fine dust it has been handling.

This Hagan collector not only enables Pittsburgh Coke and Chemical to comply with rigid air pollution regulations, but recovers valuable material as well. Add the economies that result from the sharp reduction in maintenance costs, plus the fact that the Hagan Collector is easily installed, and you have a cost picture that offers both short range and long term economies.

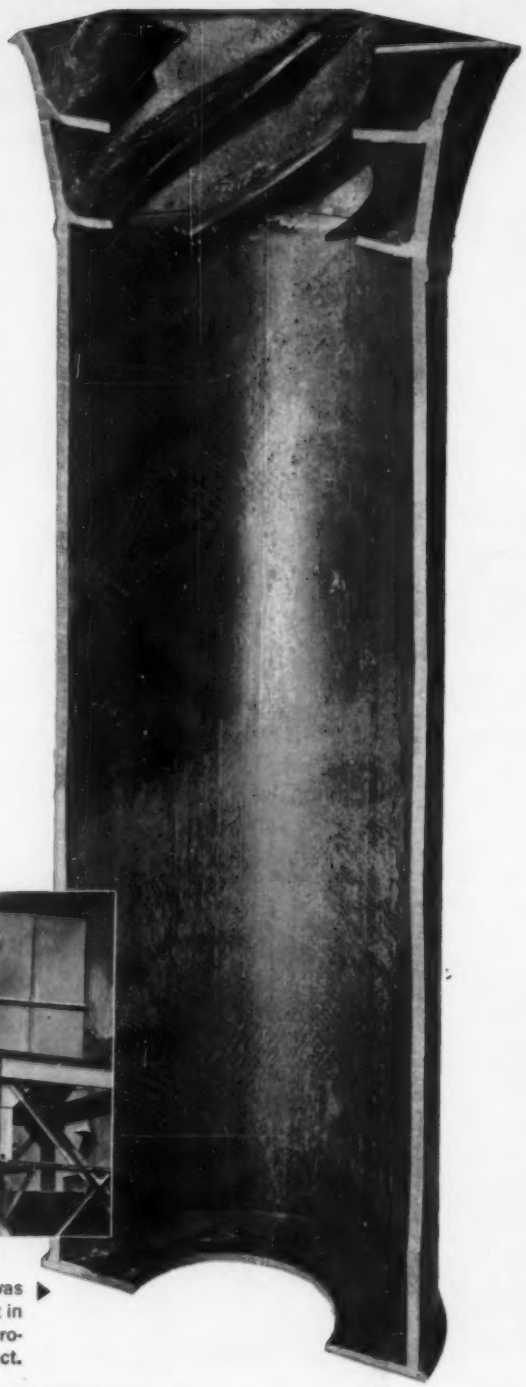
Get the full facts on how the exclusive Hagan principle of Selective Particle Acceleration can save you money. Write for Bulletin MSP-124 A.

HAGAN CHEMICALS & CONTROLS, INC.

DIVISIONS: CALGON COMPANY, HALL LABORATORIES

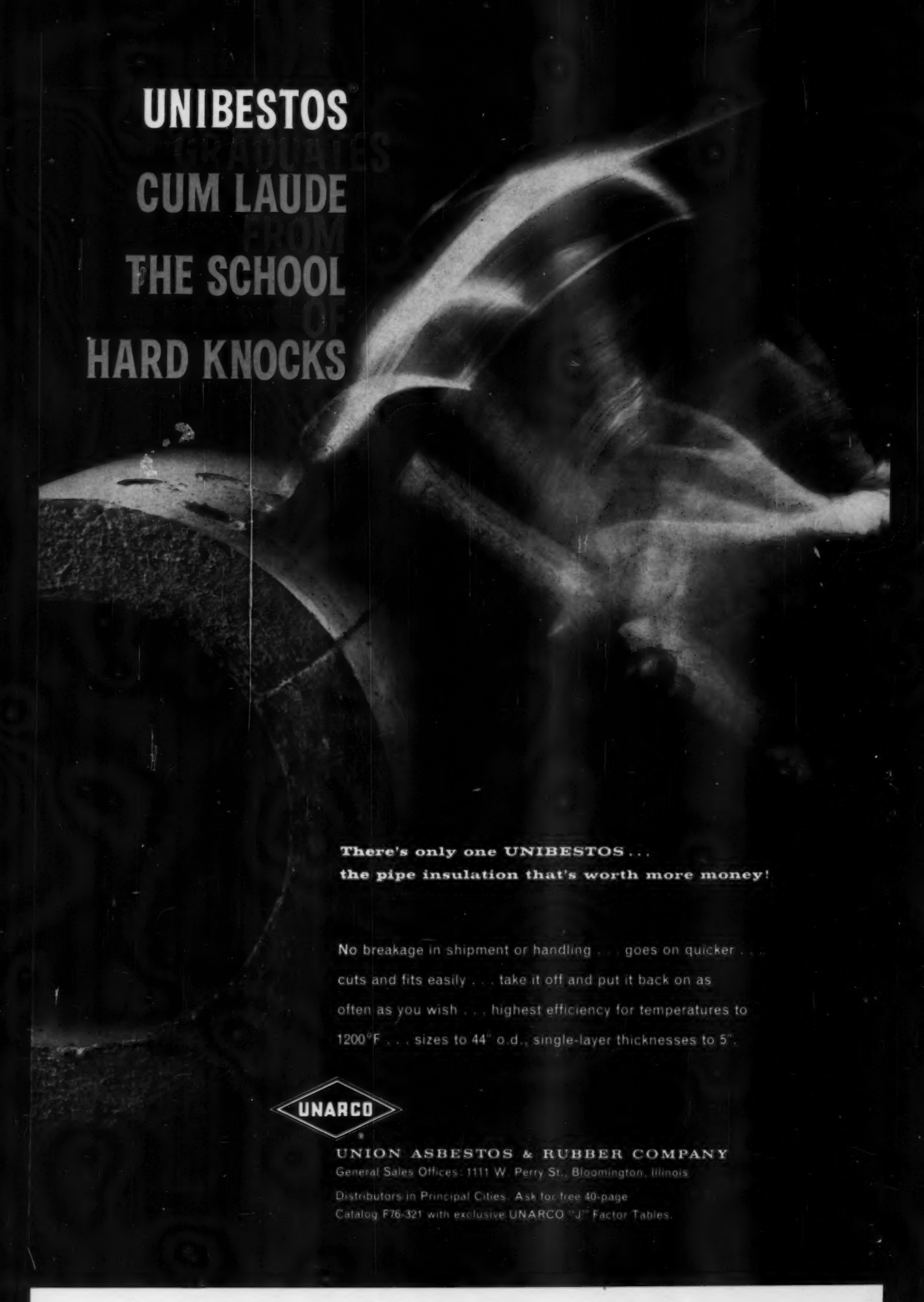
HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Flumendosa No. 13, Milano, Italy

Installation of a Hagan Dust Collector. The fast installation possible with the fully pre-assembled Hagan unit is a money and time saver.



More than 160 tons of highly abrasive slag dust was collected by this tube over a period of 15 months. Cut in half for inspection, the tube shows no evidence of erosion; in fact, most of the mill scale still remains intact.

For more data circle 539 on Post Card



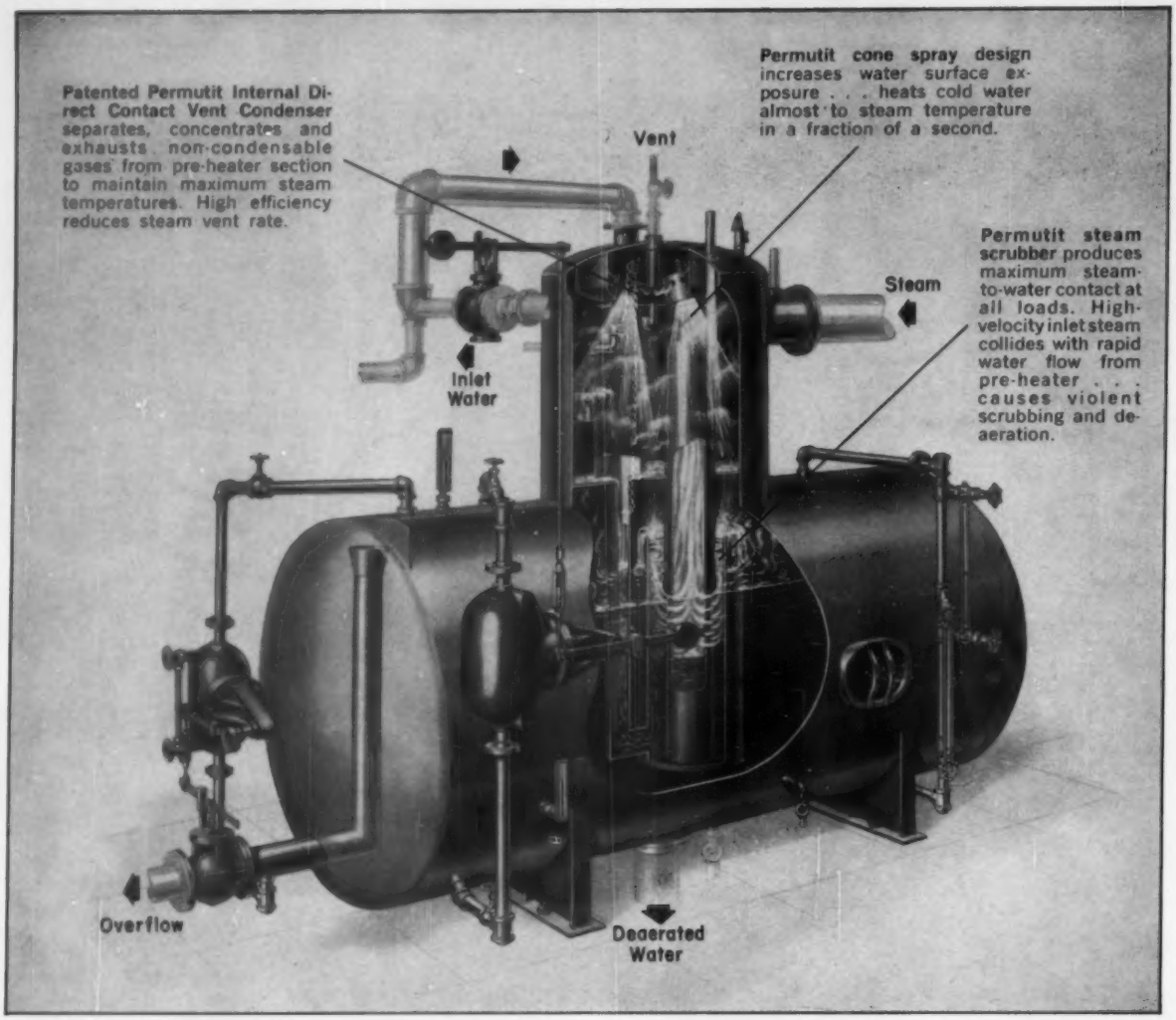
There's only one UNIBESTOS . . .
the pipe insulation that's worth more money!

No breakage in shipment or handling . . . goes on quicker . . . cuts and fits easily . . . take it off and put it back on as often as you wish . . . highest efficiency for temperatures to 1200°F . . . sizes to 44" o.d., single-layer thicknesses to 5".

UNARCO®

UNION ASBESTOS & RUBBER COMPANY
General Sales Offices: 1111 W. Perry St., Bloomington, Illinois

Distributors in Principal Cities. Ask for free 40-page Catalog F76-321 with exclusive UNARCO "J" Factor Tables.


Patented Permutit Internal Direct Contact Vent Condenser separates, concentrates and exhausts non-condensable gases from pre-heater section to maintain maximum steam temperatures. High efficiency reduces steam vent rate.
Permutit cone spray design increases water surface exposure . . . heats cold water almost to steam temperature in a fraction of a second.
Vent
Steam
Permutit steam scrubber produces maximum steam-to-water contact at all loads. High-velocity inlet steam collides with rapid water flow from pre-heater . . . causes violent scrubbing and deaeration.
Inlet Water
Overflow
Deaerated Water

New package deaerators guarantee less than 0.005 ml/L of oxygen at all loads

Permutit Type B Deaerators are available in horizontal and vertical designs with capacities up to 150,000 lbs./hr. All sizes reduce oxygen to the lowest measurable amount . . . at all loads. All sizes offer low head-room dimensions and simplicity of design to reduce maintenance. No trays to be removed or cleaned. Tubeless internal vent condenser eliminates tube cleaning or replacement. All units certified ASME Code.

Package sizes for fast shipment

Three horizontal sizes (see illustration) are available from stock: 30,000, 50,000 and 70,000 lbs./hr Complete drawings, installation and operating instructions are available on order. Shipments normally made 2 to 3 weeks from receipt of order. All internals, including sprays, are completely assembled. Float-cage and gauge-glass piping and valves are pre-fitted to simplify installation.

Capacities up to 3,000,000 lbs./hr.

Type A Deaerators are designed for larger capacities from 150,000 to 3,000,000 lbs./hr. Vertical and horizontal arrangements available to meet specific space requirements. The basic simplicity and low maintenance cost of Permutit Deaerators have been proved by over 1100 units in use . . . many in operation as long as 19 years in leading industrial and public power plants.

Other Permutit boiler feedwater equipment: aerators, chemical feeders, precipitators, pressure or gravity filters, zeolite and hot-process softeners, dealkalizers, demineralizers, vacuum deaerators, control cubicles, CO_2 analyzers, blow-off equipment. For details, write: The Permutit Company, Dept. PE-29, 50 West 44th St., New York 36, N. Y.

PERMUTIT®

rhymes with "compute it"

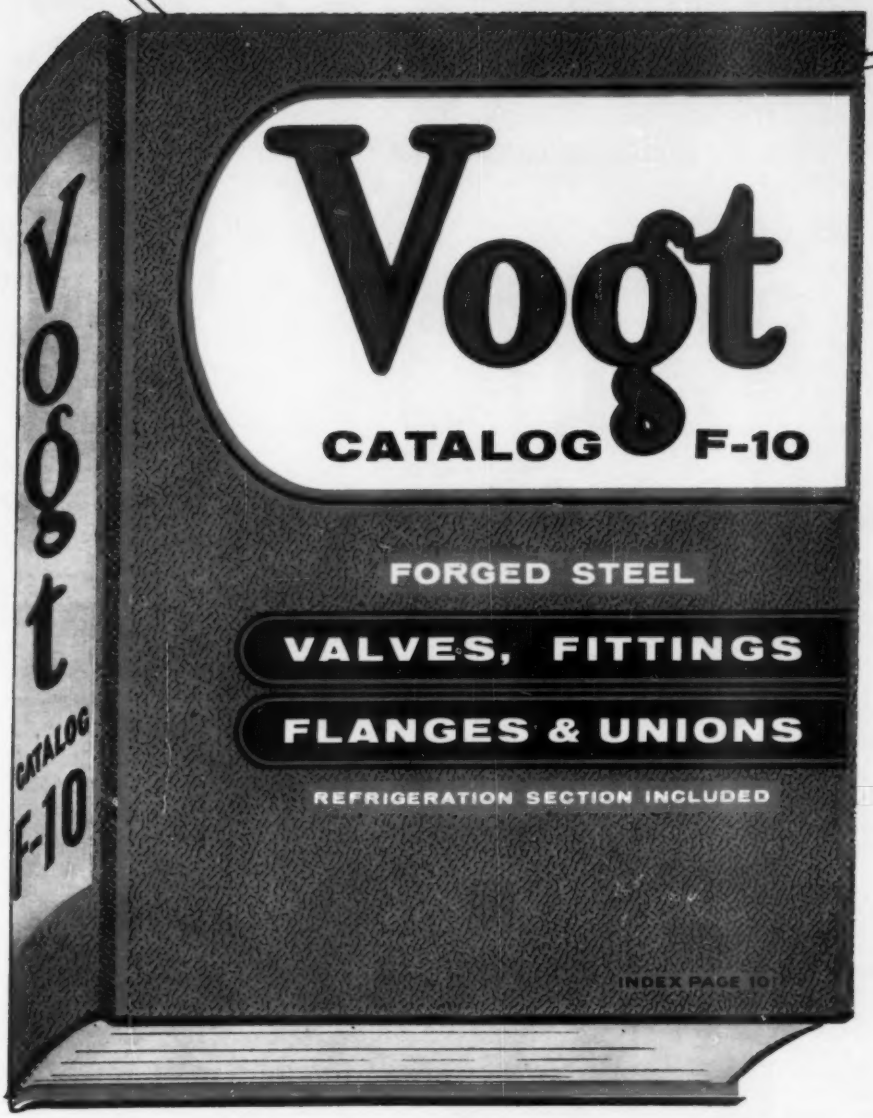
A DIVISION OF PFAUDLER PERMUTIT INC.

Water Conditioning
Ion Exchange • Industrial Waste Treatment

For more data circle 541 on Post Card

Presenting a NEW

Vogt Blue Book



Catalog F-10 is the one source for the most complete line of forged steel valves, fittings, flanges, and unions available to industry. Its 432 thumb indexed pages feature new types and trims to best meet severe fluid and gas handling duties at all temperatures and pressures.

A copy of this new catalog is available to you. Please send your request, on your company letterhead, to Dept. 24A-FPE.

Leading petroleum refineries, petro-chemical and chemical plants, and power plants get top performance with safety from Vogt forged steel valves, fittings, flanges, and unions.

OTHER VOGT PRODUCTS:
Steam Generators, Petroleum Refinery and Chemical Plant Equipment, Heat Exchangers, Ice Making and Refrigerating Equipment

HENRY VOGT MACHINE COMPANY
LOUISVILLE, KENTUCKY

SALES OFFICES
New York, Chicago, Cleveland, Dallas, Camden, N.J., St. Louis, Charleston, W.Va., Cincinnati

For more data circle 542 on Post Card

Your *FISHER/MAN* offers you

SPEEDY DELIVERY

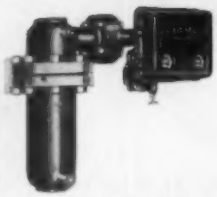
From the Factory Stocked

FISHER SUPERMARKET

Where you can shop by phone, wire or TWX

Type 657-A with 3500 positioner

Type 4150 and 4160 Wizard II Pressure Controllers



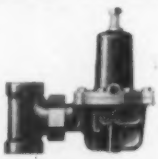
Series 2500-249 and 2500-259B Level-Trols

Type 95-H Pressure Reducing Valve

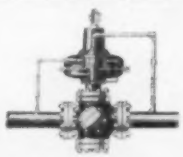
Type 630 "Big Joe" Field Regulator

Series 99 Multi-Purpose Gas Regulators

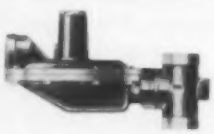
Type 655-A Pressure Regulator



Series 620 and 621 Farm Tap Regulators

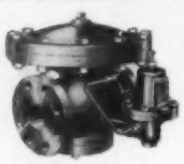


Series 298T Gas Regulators



Series S100 and 730 Service Regulators

Series 67FR Combination Filter-Regulator



Type 92B Pilot Operated Steam Reducing Valve

This "supermarket" availability of Fisher Control Valves and Controllers makes your delivery problems a thing of the past. Fisher keeps a stock of the equipment at left always on hand ready to ship to you at hourly notice. This means emergency requirements are met without costly delivery delays. This stock of control equipment includes all the most popular types in standard sizes.

In addition to the large factory stock, the Fisher offices in the column to the right which are starred carry a big selection of Fisher equipment in inventory to assist you.

Fisher constantly reviews the stock carried in the Supermarket and adds new items from time to time when your needs indicate.

Phone, wire or TWX (Marshalltown 578 or 579) and Fisher will have your order en route in a matter of hours, Saturday and Sunday excepted.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY...

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

CONTINENTAL EQUIPMENT CO. DIVISION, Coraopolis, Pennsylvania

FISHER®

SINCE 1880

For more data circle 543 on Post Card

Now, for emergency needs contact FISHER or the representatives listed below.

*AMARILLO
Vinson Supply Company
*ATLANTA
J. M. Smither & Company
BALTIMORE
The Rhodes Controls Company
BIRMINGHAM
Joseph W. Eshelman & Company
BOSTON
Clarence B. Petty & Company
BUFFALO
W. J. Sommers Company
*CALGARY-EDMONTON
Barber Engineering & Supply Company
CARACAS, VENEZUELA
Sinclair Spence
*CHARLOTTE
Robert E. Mason & Company
CHICAGO
General Meters & Controls Company
CINCINNATI
H. T. Porter Company
*CLEVELAND
A. E. Ehrke & Company
*DALLAS
Vinson Supply Company
*DENVER
Joy & Cox, Inc.
*DETROIT
DuBois-Webb Company
*HOUSTON-CORPUS CHRISTI
Puffer-Sweiven Company
INDIANAPOLIS
Acme Engineering Agency
KANSAS CITY
Sullivan-Mears Company
*LOS ANGELES
B. R. Jones & Company
LOUISVILLE
Allan K. Cook Company
MARSHALLTOWN
R. S. Stover Company
MEMPHIS–NASHVILLE
Johnson & Scott
MEXICO, D. F.
Babcock & Wilcox de Mexico
MILWAUKEE
W. D. Ehrke & Company
MINNEAPOLIS
R. G. Read & Company
MONTREAL
Process & Steam Specialties, Inc.
*NEW ORLEANS–LAFAYETTE
John H. Carter Company
NEW YORK
Crabbe & Stebbins Company
*ODESSA–FARMINGTON
Vinson Supply Company
PHILADELPHIA
Clifford B. Ives & Company
PHOENIX
Cone & Wallace Company
PITTSBURGH
J. G. Chilcoat & Company
PORTLAND
R. H. Brown & Company
RICHMOND
W. H. Kidd Company
*ST. LOUIS
H. D. Hale & Company
SALT LAKE CITY
Williams, Gritton & Wilde
*SAN FRANCISCO
George R. Friederich & Company
*SEATTLE
Power & Controls, Inc.
*SHREVEPORT
John H. Carter Company
TORONTO
George W. Beecroft & Company
*TULSA
Vinson Supply Company
VANCOUVER
Northern Columbia Process Equipment Company
*WICHITA–LIBERAL
Sullivan-Mears Company
WINNIPEG
Mechanical Valve & Engineering Spec.

Industrial Free-Piston Gasifiers in Production

Editor's Note: This is an abstract of a report published in *Gas and Oil Power*, an English journal.

PROBABLY no prime mover has expanded into active production so rapidly as the Pescara free-piston gasifier/gas turbine combination. The first vertical gasifier, built to the Pescara patents, ran at the Alsthom Works, Belfort, in 1938. Development continued during the war and immediately afterwards support by the French government in the form of backing for substantial orders for minesweeper propelling machinery and power station equipment provided the impetus for further expansion.

Alan Muntz & Co. Ltd. obtained the exclusive rights for the British Commonwealth, Eire and Egypt as far back as 1936 but it was not until 1953 that the first British manufacturing sub-licences were granted. From 1955 onwards, however, activity has increased in a marked manner and there are now a total of nine sub-licensees of Alan Muntz & Co. and twelve sub-licensees of the S.E.P. (Societe d'Etudes et de Participations) who are the parallel organization in France, being the main licensees for all territories not covered by the Muntz agreement.

Quite apart from the obvious attractions of the system which, by its flexibility, is able to provide an almost unlimited output, many manufacturers saw the production possibilities of a standard prime mover which required no massive castings, fabrications or difficult-to-obtain crankshafts and could conveniently be manufactured and assembled in a medium-sized engine shop.

Within certain limits the combination, for electric power generation, is cheaper than other conventional means. An advantage is gained over the diesel generator set due to the greatly increased alternator speeds (particularly above 3000 kw) which make the electrics of the installation very much smaller and cheaper. Although a turbo-alternator unit is similar in cost, the gasifiers corresponding to the high-pressure and temperature boilers, condensers and other ancillaries are much cheaper.

A.B.E. Group's Participation

The Free Piston Engine Co., Ltd. was established in 1956, within the Associated British Engineering Group to acquire a licence from Alan Muntz & Co., Ltd., for the manufacture and sale of Sigma GS34 and Muntz CS75 gasifiers.

At the works of British Polar Engines Ltd., another A.B.E. company, at Govan, these gasifiers are in series production for both industrial and marine applications.

The Govan company has a long history of diesel engine manufacture having been established shortly after the first world war to build Fiat-type auxiliary engines. It is interesting to observe that the cylinder bore of the GS34 gasifier is the same as that of the most popular British Polar product, the ubiquitous 340 by 570 mm N-type engine. British Polar have recently re-tooled for increased production and their additional capacity is being applied to the manufacture of gasifiers.

The Free Piston Engine Co. has received two very important industrial orders. One is for 15 gasifiers which will supply power gas to a ring main feeding a number of turbo compressors. Two of these gasifiers are being made by British Polar Engines for the Free Piston Engine Co. and the remainder will be supplied by SIGMA in France. Others going through the shops are part of the first batch of eight comprising a total order for 48 which are being supplied for the St. James Power Station, Singapore, and which constitute the largest gasifier/gas turbine order yet placed. The first of these was shipped for erection overseas in November. These 48 sets will be arranged in six groups of eight, each group supplying one C.E.M.-Brown Boveri gas turbine, coupled to a 6000 kw alternator.

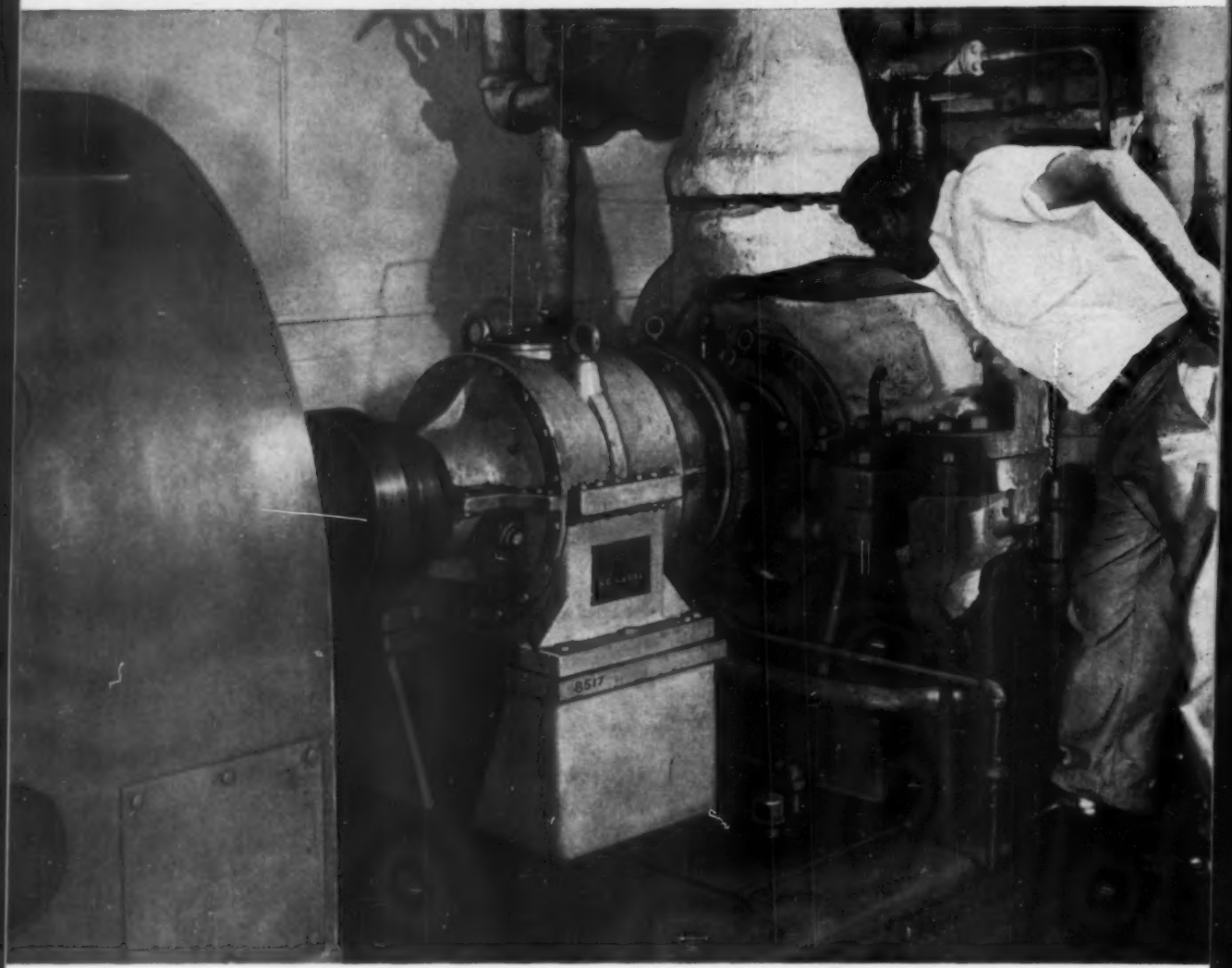
While the appearance of the British Polar built gasifier is identical with the SIGMA GS34, some detail modifications have been made in order to assist production and assembly methods.

Control is uncomplicated and the use of a single handwheel for all starting operations is commendable. This will be an advantage when operating staff, often prejudiced when new machinery is introduced, comes to be instructed.

The GS34 gasifier has a continuous maximum rating of 1250 g.h.p. corresponding to about 1000 b.h.p. per unit for small outputs but rising with the increasing efficiency of the larger gas turbines used. For large powers multiple gasifiers are required but this is no problem as they weigh only 8½ tons and the system confers complete flexibility of layout, even to the extent of vertical stacking, where space is limited.

The gasifier has special advantages where erection abroad has to be undertaken. Due to its light weight and compact dimensions it can be shipped as a single unit and indeed could well be carried by air. Only light foundations have to be provided so that the cost of the civil engineering work is much reduced. The gas turbo-alternator set must, however, be laid out in the conventional manner. The gasifier offers considerable advantage for oil field operation and, within three years, it is expected that a gasifier will be running on gas as fuel.

Creative Engineering by DE LAVAL



De Laval-Stoeckicht Gear at Homasote Co., Trenton, N. J.

2800 Horsepower in a 22" package!

That compact "package" you see in the center of the picture above is a De Laval-Stoeckicht Planetary Gear. Developed by W. G. Stoeckicht in Germany, this gear has been proved in hundreds of European installations. It is capable of transmitting 2800 horsepower from the steam turbine at the right to the generator at the left. It weighs only 900 pounds. A conventional gear for this service would weigh 4000 pounds. And the De Laval-Stoeckicht gear takes up less than half the space of a conventional gear. This is another example of how De Laval *creative engineering* plus precision manufacturing and highest quality control assure lasting customer satisfaction.

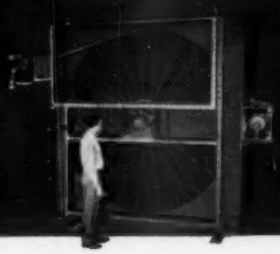
DL 440

DE LAVAL *Steam Turbine Company*

816 Nottingham Way, Trenton 2, New Jersey

HERE'S WHAT YOU CAN DO ABOUT THE HIGH COST OF FUEL

GET MORE HEAT FROM EVERY FUEL DOLLAR WITH A Ljungstrom® Package Air Preheater



By recovering heat from the exhaust gas, the Ljungstrom Air Preheater can increase combustion temperature as much as 400° or more! By raising furnace temperature this way, you permit more heat to be absorbed into boiler tubes or heat transfer surfaces. The results are increased capacity and greater output from every fuel dollar you spend.

And when you credit fuel savings, the installed cost of a Package Ljungstrom can be paid for in approximately two years.

You get maximum heat recovery because the Ljungstrom's exclusive rotary heat transfer element puts the heat back directly into the combustion air, i.e. without passing it through heat-absorbing partitions or tube walls. Package design also gives you all the advantages and economies of the Ljungstrom in a compact, pre-assembled unit. Available in vertical or horizontal models, Package Ljungstroms are readily adaptable to any plant arrangement.

For further information, write today for the free 14-page Package Ljungstrom manual.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

For more data circle 555 on Post Card

THIS IS THE TRAP FOR HIGH PRESSURE POWER PLANT JOBS

Pressures *high?* Temperatures really *hot?* Then the Yarway Integral Strainer Trap is the steam trap for the job.

Yarway Integral Strainer Impulse Steam Traps drain some of the hottest steam lines in the country, with temperatures to 1050°F and pressures as high as 2500 psi.

These traps have ample capacity when system is being warmed up, yet handle relatively small amounts of condensate without losing prime. In the presence of dry or superheated steam, the trap valve snaps shut.

Utilities and other high pressure plants also benefit from further advantages like *small size, light weight, steel construction, easy maintenance.* Available in six sizes, flanged or welding ends.

Over 1,250,000 Yarways already sold. For full information, call your local Yarway Representative or write

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

SERIES 60—normal needs, pressures to 400 psi, 6 sizes. **SERIES 120**—normal needs, pressures to 600 psi, 6 sizes. **SERIES 40**—for extra heavy loads, 5 sizes. **NO. 30**—for extra light loads (½" only). **INTEGRAL STRAINER**—highest pressures and marine use, 6 sizes.

YARWAY *impulse® steam traps*

For more data circle 545 on Post Card

TRACERS

Power Engineering's Monthly Probe of Power Facts

Thermoelectric generators which operate with an efficiency of about 6 per cent have been announced by Minnesota Mining and Mfg Co. The generators use heat applied to semi-conducting materials. One of them, shown here, is a 5-w unit about the size of a quart fruit jar. It is intended for use with an isotope heat source, and is cooled by air. Similar units are being designed for cooling with water or by radiation.

What's new in waste treatment techniques in the corn wet-milling industry? A. E. Staley Mfg Co offers two new ideas — a submerged culture process and a cooling tower that purifies. For details, turn to the article by J. C. Reynolds and R. J. Mauterer, page 88 this issue.

Five big power transformers recently installed at Consolidated Edison's Queensbridge substation in New York have sound levels almost as low as pole-type distribution transformers. The five identical 70,000-kva units have averaged less than 50 decibels when tested in General Electric's Sound Laboratory.

New design will be used by Westinghouse on high-pressure elements for turbines with ratings between 170 and 325 mw. By redesigning the element so that the steam first runs through two-thirds of the blading, then between the inner and outer cylinder walls, and back through the last third of the blading, a lower temperature difference results across the inner cylinder wall. Reduction of balance piston diameters is obtained at the same time, as blading thrusts are balanced, so that better over-all leakage efficiency is also obtained.

New source of power has been found for the natural gas industry. The principle is simple. A Troy engine operating on a normal steam engine cycle is used as a reducing valve between the higher pressure of gas dehydrator discharge line and the lower pressure feed to a transmission pipeline, thus providing the desired differential-pressure or cascading action to furnish power. As it is only the flow of natural gas through the engine that provides the power, no gas is actually consumed by the engine or lost to the atmosphere, while the engine is in operation. First application is now in 24-hour daily service pumping water. The engine develops 60 hp and drives a pump that is displacing water from a deep well at a rate of 600 gpm.

Use of a new grease-like silicone compound on line insulators in an electrical system is proving to be effective in preventing fires and flashovers and in saving on maintenance labor. The material is simply wiped onto the insulators with a cloth. Gordon Sandall tells of his experience with it at Alpena Power Co, in an article scheduled for publication next month in POWER ENGINEERING.

First of its kind, a control arrangement using silicon rectifiers will insure continuity of critical processing for the Kodak Park Works. The rectifiers will provide control power to switch all loads automatically to a second primary source should the first source fail. For the "how" of this unique system, turn to page 77 this issue.

Photos courtesy of Aluminum Co of Canada, Ltd.

Fig. 1. Site of Aluminum of Canada's project. Narrow canyon at left named it Chute-des-Passes. Access tunnel is in center

Underground Station Adds 750,000 kw

POWER SUPPLY for Canada's burgeoning aluminum industry will receive a tremendous boost when the first of five new hydroelectric generating units goes into service in August, 1959. This most northerly hydro project in the Province of Quebec is at Chute-des-Passes and is being built for Aluminum Co of Canada. It will supply power to the Alcan smelters 150 miles to the south.

Chute-des-Passes is on the upper part of the Peribonka River in a region already developed to some extent by the mining and pulp and paper industry. Access to the site is difficult, with the most convenient transportation being by chartered plane from Montreal, flying over the Laurentian Mountains. A small bush airline, typical of Canadian pioneer aviation, has made the 4000 ft long landing strip at the power project a regular stop.

Powerhouse of 1 million horsepower is being built to utilize available flow of the Peribonka at this site. Besides being in a very remote area, this project is unusual because of the fact the powerhouse is entirely underground. That Alcan's project manager is a mining engineer is significant, since construction has involved digging a tunnel six miles long through pre-cambrian rock. Logistics in building the project were considerable as access had to be built in the form of a 150-mile highway capable of withstanding the hauling of heavy equipment.

Project utilizes a reservoir already created by the Passe Dangereuse Dam built in 1945, tapping off the water about 200 yards above this dam on the Peribonka River. Previously, water was released to supply two power dams 100 miles downstream, which still is the case except that under the new system it will first pass through the tunnel to the underground powerhouse at Chute-des-Passes and then empty again into the same river.

Construction of the 34 ft diameter horseshoe-shaped main tunnel over six miles long, and tunnelling out the power station cavern was a task of considerable magnitude. More than 3 million cubic yards of rock had to be drilled, dynamited and excavated. Nearly half a million cubic yards of concrete were poured to line the tunnel and powerhouse chamber.

By using a tunnel six miles long, Alcan will be able to obtain a *head* or vertical drop of water of 630 ft. One million horsepower thus obtained will bring the company's hydroelectric system up to a total capacity of 3,580,000 horsepower.

Access to the underground workings was obtained by excavating three entrance tunnels from which it was possible to work in two directions

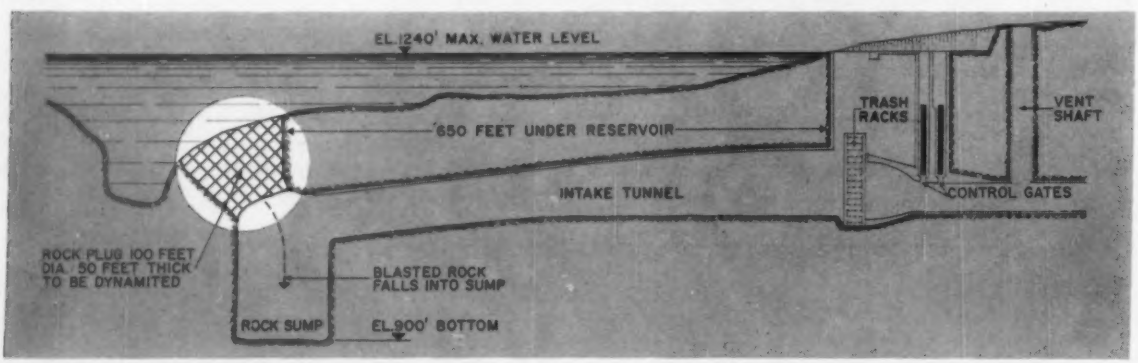


Fig. 2. Diagram showing technique to be used to blast rock plug for intake tunnel. Sump will hold 15,000 cu ft of rock

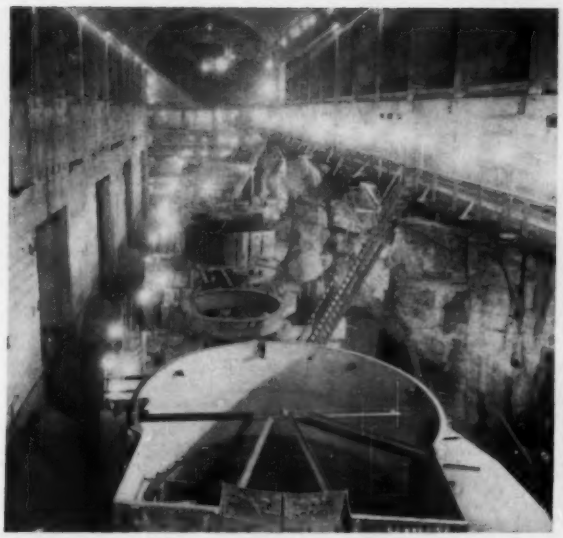


Fig. 3. This powerhouse is 500 ft underground. At left are openings for penstocks connecting with the five turbines

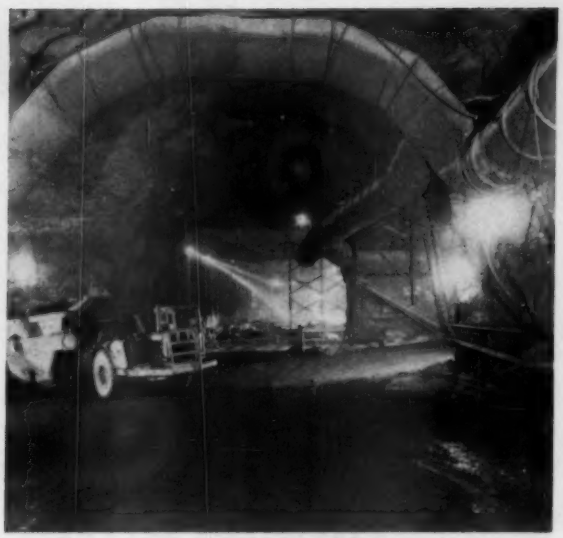


Fig. 4. Access tunnel to powerhouse under construction in background. Overhead pipes carry forced air for ventilation

Hydro Power for Canadian Aluminum

at each heading. Another two mile tunnel was drilled from the powerhouse downstream to provide discharge for the water, incorporating the unusual feature that it passes underneath the river into which it eventually discharges. This tunnel is left unlined and is 48 ft in diameter. Main 34-ft tunnel is concrete lined.

Another unusual feature which seldom has been attempted elsewhere in the world is the method of building the intake to the tunnel at the bottom of the reservoir near the dam. This intake is 130 ft below water level and projects 600 ft under the reservoir. A 100 ft diameter plug, 50 ft thick, will be blasted out in one shot at the end of the intake tunnel, Fig. 2, with the rock from the blast falling into a hole previously excavated. This hole will be large enough to receive 15,000 cubic ft of blasted rock.

Installation has a surge tank to adjust to changes in water demand and also to take up the backlash of the water in the event an emergency requires closing down the powerhouse suddenly. Surge tank is about 2000 ft upstream from the plant and consists of a 130 ft diameter tank, 250 ft high, connected with a 35 ft diameter shaft, 300 ft long. This has been excavated out of solid rock. An overflow basin in the form of a channel, also in solid rock, is provided to store 2 million cubic feet of water if required.

From the main tunnel, water will be fed by five steel-lined tunnels or penstocks, fourteen ft in diameter leading into the powerhouse. Latter is a vast chamber 465 ft long, 70 ft wide and 70 ft high, located 500 ft below the surface, Fig. 3. Power chamber has a concrete arch ceiling with two 210-ton overhead travelling cranes spanning the powerhouse. Penstocks form a manifold which feed into five turbine-generator units, each rated at 200,000 hp. Another manifold will receive the discharge water on the other side of the installation. Instead of lining the discharge tunnel with concrete, aluminum rock bolts have been driven into the tunnel walls and overhead for support. Total of 120,000 bolts were used for the purpose.

Aluminum bus bars will carry power from the generators through vertical shafts to the surface 500 ft above, terminating at an outdoor substation. To service these, a 500 ft elevator is being installed and will provide access to the power plant. Another permanent access will be through a tunnel, used during construction, which starts near the bank of the Peribonka River and descends 120 ft along a curving route. Two high-tension lines will carry the power at 345,000 volts to the Isle Maligne terminal station to join Alcan transmission system. THE END

Principal Features of the Chute-des-Passes Hydroelectric Power Project

Location:	On Peribonka River, 90 air miles and land miles north of Isle Maligne, Quebec, Canada.	Depth of power house floor below ground level:	About 500 ft
Capacity:	One million horsepower	Rock excavation:	3 million cubic yards
Total Estimated Cost:	$140 million	Concrete quantities:	420,000 cubic yards
First Unit to be in Service:	August, 1959	Turbines:	Five 200,000 hp Francis type vertical shaft waterwheels
Operating Head:	540 feet	Generators:	Five 165,000 kva, 60 cycle, 0.9 power factor, 14.4 kv
Length of Supply Tunnel:	30,854 feet (nearly six miles)		
Length of Tailrace Tunnel:	9000 feet	Total length of Access and Construction Tunnels:	10,427 ft
Cross Section of Supply Tunnel:	Modified horseshoe shape, concrete lined, 34 ft, 4 ins. nominal diameter	Transmission Line:	100 miles to Isle Maligne terminal station, at 345,000 volts
Cross Section of Tail Race Tunnel:	Circular, unlined, 48 ft diameter		

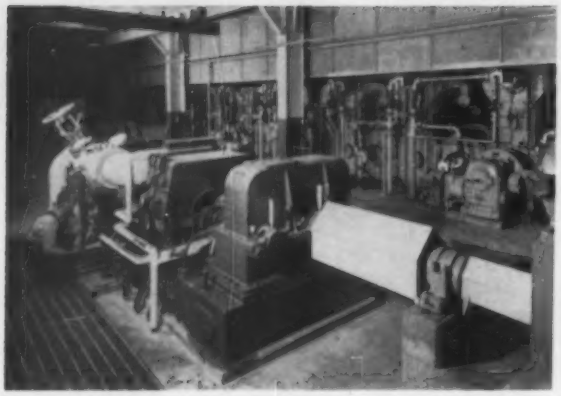


Fig. 1. Principal use of mechanical-drive turbine in the paper industry is its application as paper machine drive

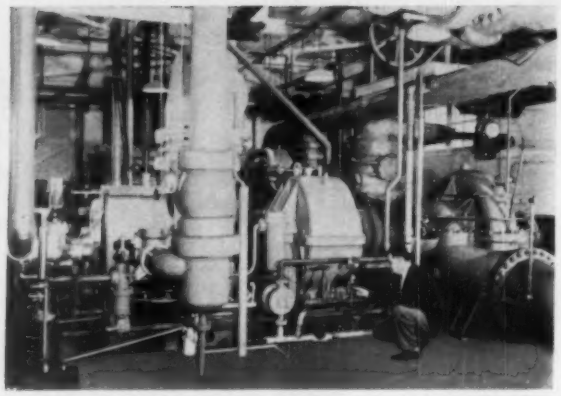


Fig. 2. This 1500 hp condensing turbine and gear saves Btu, utilizes low-cost exhaust steam to drive a 23,000 gpm pump

Turbine Drives Mean Steam Economy

IMMEDIATELY APPARENT in an age of changing industrial power trends is the swing to wider and more varied use of mechanical turbine drives. With added advantages in system flexibility, turbine drives are today finding wide acceptance in the paper, chemical, petroleum, steel and food processing industries, to name but a few.

Particularly attractive is the application to those industries in which large amounts of process steam are required at different pressures. When turbines can be operated as mechanical drives utilizing bleed or exhaust steam from units at higher pressure levels within the same system, their use is an economic mandate.

J. T. Judge of International Paper put his finger on the pulse of one facet of this swing in his paper before the 1958 National Power Conference, Trends in Power-Plant Design for Modern Paper Mills. Said Judge, Mechanical drive turbines are used widely in paper mills to drive paper machines and such power plant auxiliaries as boiler feed pumps, boiler fans and special emergency equipment. High-speed paper machines require more horsepower to drive them, and some of the more recent drives installed were for more than 4000 hp.

There is a large oil refinery in Sinclair, Wyo., that has over 1000 turbines ranging in size from 5 hp to the 5,000 kw unit that furnishes electric power to the installation. All critical pumps, fans and compressors are turbine-driven. Steam pressures vary from 650 psig, at the turbine-generator throttle, to 10 psig.

Turbines in Chemical Process

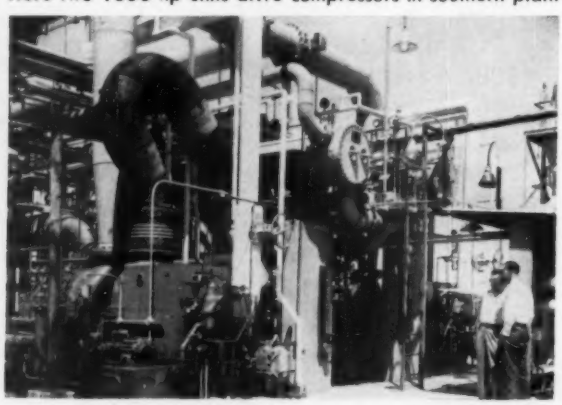
Diamond Alkali recently completed installation of a 1500 hp condensing turbine which, through gear arrangement, drives a large centrifugal pump, Fig. 2. Throttle pressure is 150 psig, with the unit exhausting into a vacuum. A novel feature is the incorporation into the turbine of a 6-inch induction opening which allows it to use excess low-pressure exhaust steam at 12–18 psig from other turbines in the system. Such an arrangement permits utilization of extremely economical steam for approximately 70 per cent of this turbine's requirements. Pump driven by this unit is rated 23,000 gpm against a head of 198 ft.

Eastman Kodak has a number of such applications. Ten low-pressure turbines, totaling 12,440 hp, drive refrigeration compressors that add up to 8850 tons of refrigeration at Kodak's Rochester plant. All these turbines use exhaust steam from other mechanical drives at 4 psig and exhaust to 26 inches vacuum. Another, at Kodak's Kingsport, Tenn., plant, is rated 286 hp, drives a refrigeration compressor with a nominal rating of 350 tons.

The Rochester plant generates over 95 per cent of its electrical and mechanical power requirements. Electrical generation is all with extraction and back-pressure machines, in addition to which there are a large number of higher-pressure mechanical drives exhausting at 5 psig. During winter months large quantities of this exhaust is used for process and building heat. In summer, most of the surplus steam is condensed in refrigeration drives. THE END

Fig. 3. Turbine drives find increasing acceptance in feed-pump applications as process requires added exhaust steam

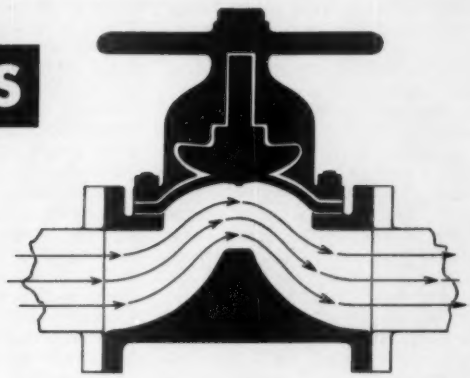
Fig. 4. Chemical industry makes wide use of turbine drives. Here two 1358 hp units drive compressors in southern plant



Power Engineers' Valve Manual . . . .

Continuing the series on basic valve types used in the power field, this article tells the story of Diaphragm valves. Due to its inherent design, this type lends itself most effectively to applications in the chemical processing field where corrosion is most prevalent and costly

DIAPHRAGM VALVES



By R. McFARLAND

Technical Director

Hills-McCanna Company

Chicago, Ill.

Mr. McFarland graduated from the Illinois Institute of Technology in Chemical Engineering in 1934. Later, he did graduate work in Organic Chemistry at the University of Chicago until 1937.

For twenty years, Mr. McFarland has specialized in corrosion materials of construction and chemical processing. He is Technical Symposia Chairman for the NACE 1959 Conference.

He is also Secretary of his company, a Director of NACE, and a member of ACS, AICNE, ASM, SPE and MSS.

Editor's note: With this wide experience in the valve field, and in the study of corrosion-resistance, Mr. McFarland is ably qualified to write on the subject of diaphragm valves. This background provides another authoritative article in Power Engineering's valve series, which will soon be reprinted as a complete Valve Manual. Write now if you wish us to reserve a free copy for you.

IN TWENTY-FIVE YEARS, the diaphragm type valve has become one of the industrial standard basic valve types. The valve consists of three simple elements: the valve body, the valve diaphragm, and valve bonnet assembly. The valve is illustrated, in detail, in Fig. 1.

The diaphragm in this valve serves as the closing, or seat, member as well as the partition that separates the valve working parts (bonnet) from the fluid passageway. The diaphragm is not used as a packing substitute, but instead is used as a dynamic seating element, and eliminates the necessity for the conventional valve stem packing material.

There is some confusion in the engineering profession as regards the meaning of the word *diaphragm* when referred to valves. An older connotation of a *diaphragm* has been used by the instrument engineers and manufacturers to denote an outside stem — packed valve, with the stem and throttling element moved by a remote air-motor diaphragm, reacting against a precision spring. (This results in a precise increment of valve stem movement, with relation to air pressure, on the diaphragm motor.) The diaphragm valve to which we refer, and as illustrated, is a valve of truly basic diaphragm design, actually utilizing the diaphragm for closure and separation of the valve working parts from the valve body member.

Tight Closure Feature

The attribute of bubble-tight seat obtainable through the rigid valve weir, and diaphragm seal, creates the principal field of use in those services where drip-tight, bubble-proof closure is mandatory. Today, increased industrial processing costs have come to make this feature paramount, and it is desirable to eliminate wastage of even air and water leakage. All too often, this is thought of as inconsequential. As an example of this, one of the largest automobile assembly plants in the nation is completely equipped with diaphragm valves, in sizes from ½ to 12 inch, for air service, at pressures of 100 psi. In this case, initial trials in a prior plant test proved conclusively that the air — escape-free closure saved so much air, normally encountered in accepted leakage, that the valve installation would be rapidly amortized.

In like manner, the valve with this resilient seat feature is very satisfactory in simple water service, particularly where the water may contain grit or suspended material, or be corrosive or scale forming. In this respect, it is even more important that the valve be completely opera-

tive after extended service with corrosive and scale-forming water; and without the valve becoming clogged, scaled or cemented shut through long standing. Hence, pitting, corrosion and tuberculation (while not desirable), can be tolerated without the valve becoming inoperative.

Chemical Applications

With the feature of tight shut-off, and with the attributes of a wide selection of construction materials, the valve has accordingly become the industrial standard in chemical process work, where the majority of corrosive processing reagents can be satisfactorily contained within the pressure and temperature limits of the valve Only reasonable maintenance is required in such cases. These chemical uses have become so widespread that over 700 different process applications have been registered — handling organic and inorganic, corrosive chemical reagents.

The ability of the valve body to be glass, plastic, or soft-rubber-lined — or utilize a host of other construction materials — has permitted it to find application in very severe chemical or abrasive services. Typical are: suspended rouge, alumina, sand, cement, fly ash, lime, gravel and air-blown powders. This can be accomplished by the proper selection and combination of valve body and the particular diaphragm material required for the type of service to be encountered.

Also, the valve has found wide application on such stringent industrial services as vacuum, down to a fraction of a micron, with low leak rates. This has permitted the application of the valve in electronic component manufacturing and pharmaceutical and chemical manufacturing, where the process involves high-vacuum techniques.

A very important example of a difficult application is the wide use of this valve in ion-exchange work for water demineralization. The production of high-ohmic water has resulted in hundreds of installations, utilizing this valve in laboratory and plant demineralizers. For large power plants, particularly, it is important that absolutely no leakage occur in cross-branching, and between resin beds and valve manifolds, so as not to experience regenerant leakage, or demineralized-water contamination.

Diaphragm valves range in size from ½ in. to 16 inches; with screwed and flanged-ends available in sizes ½ in. to 3 in.; however, flanged-end only in sizes 4 to 16 inch inclusive. The standard elastomeric rubber-base diaphragm operating temperature is from 180 F to 220 F for special heat-resisting diaphragms. The working pressure of the valve is 150 psi in sizes ½ to 4 in.; 125 psi in sizes 5 and 6 inch; 100 psi in 8 in. size; 65 psi in 10 and 12 inch; and 50 psi in 14 and 16 inch sizes.

Due to wide variety of diaphragm and body materials required in specific services, any combination of materials with these maximum temperatures and pressures are not always mutually selective. The use of Teflon as a diaphragm material permits the use of the valve at elevated temperatures to 300 F, providing the operating pressure is correspondingly reduced. The type of chemical application at elevated temperature also has a bearing on the maximum permissible pressure, and the valve body construction and type of bonnet assembly best suited for the particular application.

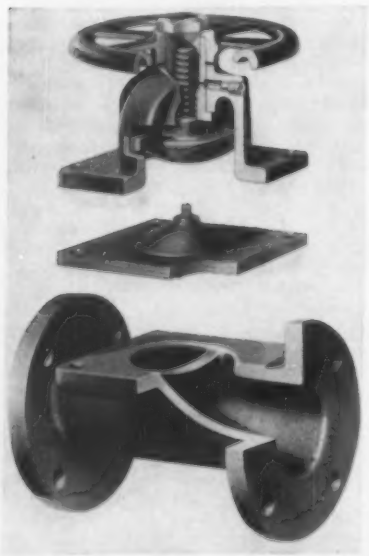


Fig. 1. Main parts of diaphragm valve: body; diaphragm; bonnet assembly

Wide Versatility of Valve

There are several thousand material combinations available, in the broad list of diaphragm and valve body types on the market. For example, in the valve body material, the most popular materials are glass-lined, soft-rubber-lined, plastic-lined (many types), hard-rubber lined, cast iron, nodular iron, stainless alloys of different varieties, structural carbon, structural plastic (phenolic, PVC), aluminum bronze, everdur, nickel alloys of many types, polished stainless steel and others.

These valve body materials can be supplied, in most cases, in either screwed-end or flanged-end; also, some types in sanitary-end (polished stainless), brazed-end, or many types of special flanged designs, are available. The diaphragms are obtainable in rubber-base, neoprene, Hycar, Butyl, Teflon, Kel-F, Polyethylene, Teflon-faced and special diaphragm materials on special order.

The basic, three-element design, of body, diaphragm and bonnet assembly, gives wide latitude in the method of operation. Figures 4, 5, 6, 7 and 8 show a few of the many types, such as quick-opening, sliding-stem, cylinder-operated and motor-operated. The valve is very well suited to remote operation, either hydraulic or pneumatic, with pneumatic operation preferred for flexibility and economy.

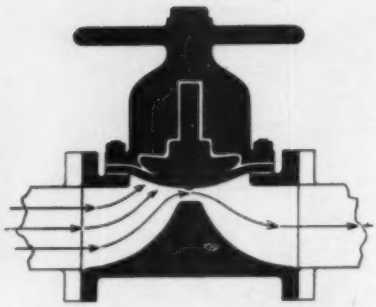


Fig. 2. Drawing of valve, in partially-open position; cleaning action is shown

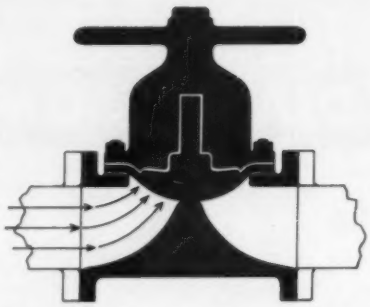


Fig. 3. Closed position of valve is shown, with closure of diaphragm on seat

Thus, the valve can be supplied with either the instrument-type diaphragm motor (with or without a positioner for stem movement precision in throttling service), or equipped with the instrument-type diaphragm motor (or air cylinder) for open — closed service. Extended handwheel, chain handwheel, gear-operated and other designs are produced and made to fit special mounting requirements as industrial valve engineering may indicate. Also, the body of the valve may be equipped with a clean-out port, steam lance, water lance, or drains. A valve which is now standard in the fermentation industry is the antibiotic-type valve, equipped with steam and condensate passages for the continuous maintenance of sterile operation.

Maintenance Features

The diaphragm in its operation, functions both as part of the valve seat, and as a separating member for the operating bonnet assembly; so, there is no need for packing. The absence of packing eliminates the necessity to re-pack the valve; thus the valve is capable of handling fluids without packing leakage.

The three-element construction has the advantage of permitting "in-line maintenance," inasmuch as the valve body need not be removed from

the line. Instead, removal of the bonnet assembly permits diaphragm replacement and re-assembly of the valve. This reduces maintenance cost involved in line removal; eliminates stem repacking, seat grinding, and the necessity for selective fits that arise in a conventional valve reassembly. The resilient diaphragm member eliminates the necessity for assembly under close tolerance conditions. Usually, as a result of this "in-line maintenance" feature, the only replacement part normally required is the diaphragm.

Adequate care and lubrication of the bonnet assembly parts will insure continued operation. It is seldom necessary to replace any of the operating parts of the bonnet assembly. With the materials available, it is possible to offer maximum corrosion resistance. Selection of the proper body material gives the optimum in corrosion-resistance, and results in long body life, with infrequent body replacement. This type of valve has become so widely used, and the technique of operation so familiar through use, that maintenance is low for those who have become aware of the attributes of the valve.

Referring to Figures 1 and 2, it will be noticed that when the valve is operated from the open to the closed position, the diaphragm movement sweeps out the volume of liquid which must be displaced into the pipe line. This then, is a displacement-type valve and cannot be utilized in so-called *locked-lines*. A gate valve, for example, is less limited in this respect, in that movement of the valve gate does not displace an equivalent amount of fluid in moving from the open to the closed position. As a result, the ordinary gate valve can be used in a locked-line manifold,

Fig. 4. Angle-type of diaphragm valve; one of many adaptations of basic valve

and closed as required for operation.

This is not true of a diaphragm valve, inasmuch as inadvertent closure in a locked-line will result in "pumping" of the liquid through positive diaphragm movement, to raise the pressure in the locked line manifold. This can reach the point where the diaphragm will break, or a gasketed surface will leak, until the displaced volume of fluid has been dispelled.

Also, because of the area of diaphragm exposed, and the inherent mechanics of the valve design, the pressure rating is limited. Obviously, pressure acting over the diaphragm surface results in a torque requirement on the valve handwheel which can become excessive. This is particularly true where the valve is used at maximum pressure in a "live-line," where the back-pressure in the valve, during closure, is near maximum. The valve is normally used for free discharge shut-off, or for low back-pressure shut-off; in this case the torque available in one-man operation is adequate. However, where the back-pressure is high, and on large valve sizes, the developed torque from diaphragm pressure reaction necessitates two-man operation. The introduction of a gear and handwheel mechanism permits manual torque-multiplication for valve closure. Obviously, the increased stress on diaphragms at these high pressures results in lessened diaphragm life.

Diaphragm valves are limited in temperature, with most elastomeric diaphragm materials, to a maximum of 180 F. However, specially-compounded, heat-resisting diaphragms are available for continuous operation to 220 F, or short-term operation at 240 F. Solid Teflon diaphragms are available for operation, at reduced pressures, to a maximum temperature of 300 F. Again, with the wide range of materials, together with corrosive-service requirements, and temperature and pressure limits, it is possible that all combinations are not mutually selective.

Shock Resistance

The resiliency of diaphragms frequently assures less damage than would normally occur in a pipe line assembly where hydraulic shock exists. Unfortunately, and all too often, the hydro-mechanics of industrial lines are either unknown, carelessly planned, or little thought is given to their possible creation and effect. Consequently, the power engineer is ultimately faced with ruptured fittings, broken valves and gages, and secondary effects, resulting from the loosening or vibration of auxiliary equipment in connection with the pipe line.

Conventional valves, incorporating precise seating tolerances, ultimately leak as a result of repeated hydraulic shock or vibration. This is partly overcome through the substitution of the resilient diaphragm. When the

Fig. 5. Photo illustrates diversity of basic valve; shown is quick-acting type

Fig. 6. Universal type, to which several means of operation can be connected

magnitude and frequency of hydraulic shock becomes sufficiently great, the diaphragm is incapable of absorbing the standing wave of the shock, and rupture of the diaphragm results. A diaphragm rupture would indicate the hydraulic malfunction existing in the pipe line. Viewed properly, this is not an indication of valve failure, as such, but rather an indication that has pointed up the need for correction of those factors causing improper hydraulic conditions.

One that may increase maintenance on the valve is inadvertent diaphragm overclosure. Psychologically, the valve operator is usually accustomed to metal-to-metal "feel" in closing a valve Instead, the diaphragm valve gives a cushion closure, and the tendency would be to continue closure until the "feel," or torque resistance, approximates that of a metal-to-metal seat. This is beyond the necessary point for drip, or bubble-tight, closure; and, to prevent such inadvertent overclosure, the valve can be equipped with a tell-tale limit stop. This device gives an indication to all operators when valve is fully closed.

The valve specifications applicable to diaphragm valves are similar to

Fig. 7. Conventional diaphragm valve, with screwed ends for pipe connections

Fig. 8. Cylinder-operated type of valve, for hydraulic or pneumatic operation

those applicable to other types of standard valves, with one exception. The valve, in some sizes, does not conform to ASA Globe Valve end-to-end dimensions, due to inherent geometry of the design. The valve can be supplied in 125 or 150 psi ASA flange specifications; also, flat-face, raised-face, or in special combinations of valve ends and flange drillings. The material of construction of the valve can be supplied according to ASTM material specifications, where applicable. During assembly and testing, the valve is tested both pneumatically and hydraulically for overall tightness and shut-off. The valve can also meet rigid assembly specifications to pass the G. E. Halogen-Snifter test; also made with special surface finishes, in combination with non-contaminating diaphragm materials, for food, antibiotic and pharmaceutical applications.

The applications of the valve are legion. As an example, nuclear applications have been very satisfactory with the handling of heavy water, solvent extraction processes, and auxiliary services in nuclear chemical plant processing. The valve has found wide application in practically all types of plating processes, inasmuch as it combines ideal corrosion-resistance while avoiding conductance or short-circuiting; also it eliminates contamination of the plating solution.

In the textile industry, the valve has had wide application in synthetic-fiber manufacture, sulphuric and hydrochloric acid handling and manufacture, and nitric acid applications.

Pulp and paper mill applications, tanning, and metal refining applications, are additional uses of valve. To further illustrate the applicability simplified, diagrammatic flow sheet showing typical industrial process where the valves have given exceptional performance refer to Fig. 9.

Summary

This valve, of all industrial classes, is capable of the greatest selection and combinations of materials of construction. Consequently, the valve has been produced with over 100 combinations of body material, and some twenty combinations of diaphragm materials. Each one of these combinations is dictated by the peculiar requirements of the corrosive solution being handled, and the temperature and pressure of operation.

While not a precision throttling device, the valve has good throttling qualities within limited rangeability, and relatively low pressure-drop characteristics. All of these attributes have further extended its application into the precision control and instrumentation field, for the controlled flow of corrosive and abrasive materials. These rigid requirements have caused this valve to lead the development of new constructional materials, as the demands of corrosion, temperature and pressure have increased. THE END

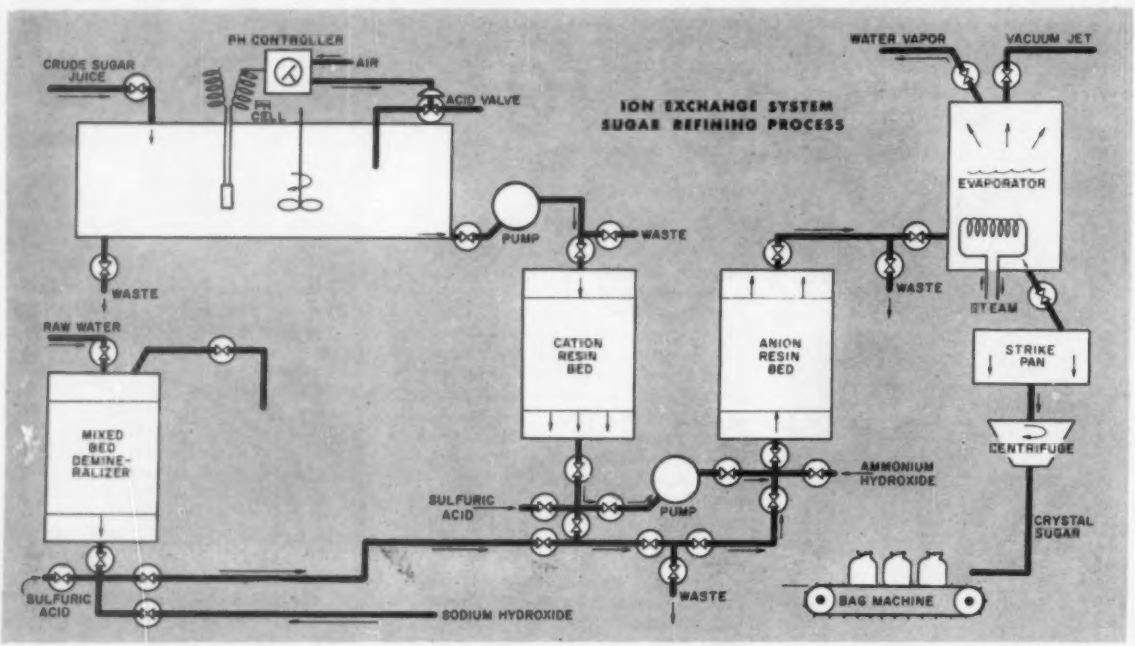


Fig. 9. This diagrammatic sketch illustrates wide use of diaphragm valves in the ion-exchange circuit of sugar refining process. Range of materials, and design of valve, makes it ideally suited to these applications. No other type is so versatile

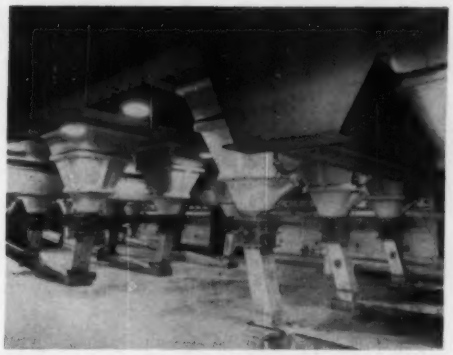


Fig. 1. Banks of collection hoppers. Rotary feeders connect hoppers to the inclined conveyors

Pneumatic conveying system has simplified handling and disposal of fly ash at State Line Station of Commonwealth Edison Co. Gone are the trucks for hauling, the wet settling beds, high costs for labor. Also, ash is now sold

State Line Improves On Fly Ash Handling

By LEONARD J. LUCKENBACH*

LIKE MANY OTHER plants, State Line Station of Commonwealth Edison Co in Hammond, Ind., used to haul fly ash from the plant in trucks. Most common way of disposing of it was to wet it down in settling beds which would at least keep some of the dust out of the air. This, however, was costly because of labor and the expense of equipment.

So the company installed a pneumatic conveying system to remove fly ash from the precipitators and transfer it through a totally enclosed system to proper storage facilities. As extra generating capacity was added to the plant the pneumatic conveying system was enlarged, until at present about 350 tons of fly ash are collected daily as a by-product.

Six banks of collection hoppers serve the dust precipitators. Each bank of these hoppers is connected by a 14 by 14-in. Fuller rotary feeder to a Fuller-Huron Airslide fluidizing conveyor (Fig. 1) which conveys high-temperature fly ash at a slightly downward pitch to a central transfer point. This is a conveyor at right angles to the first six which delivers fly ash to a 20-ton surge hopper.

Underneath this surge hopper are two Fuller-Kinyon pumps (Fig. 2). Central discharge gate on the surge hopper is divided into two motor-operated discharge chutes, each entering one of the pumps. This permits alternate operation of the pumps.

These pumps fluidize the fly ash solids and propel them through a two-way motorized diverting valve either to the bagging facilities or to the bulk handling facilities. Each unit can pump to both locations simply by switching the two-way valve.

The system is completely automatic and all operating adjustments are made at the central control board which is operated by one man on each eight-hour shift. Control panel is furnished with a flow diagram on

* Manager, Power Plant Application Section, Fuller Co

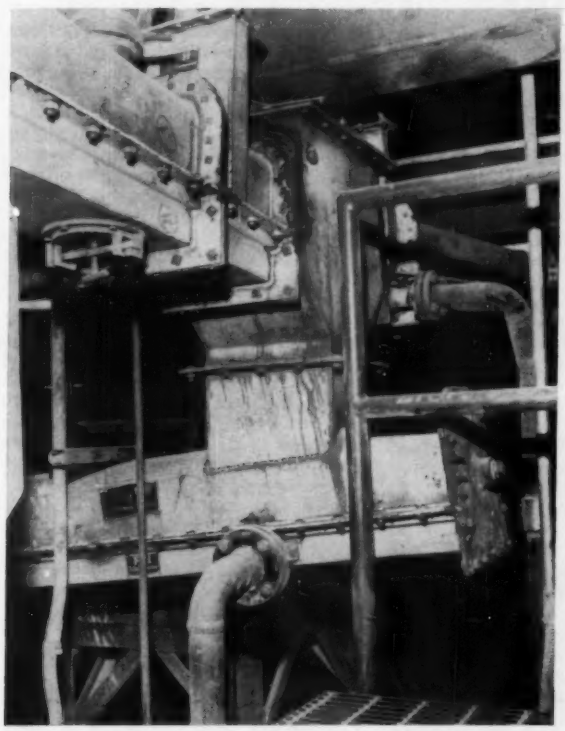


Fig. 2. Collecting Airslide conveyor transfers ash from inclined conveyors to surge hopper over Fuller-Kinyon pumps

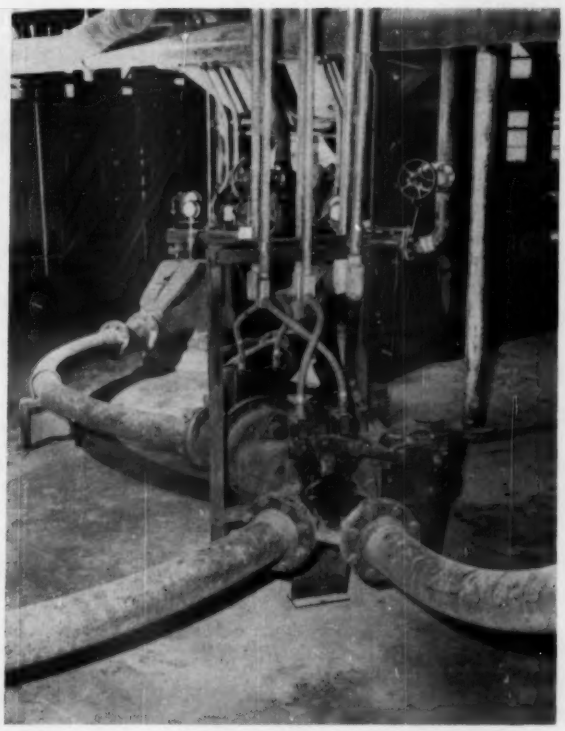


Fig. 3. Motorized two-way diverting gate permits either pump to supply both bagging bin and the bulk storage silo

Fig. 4. Fuller rotary air compressors supply compressed air for operation of pumps. Rated at 600 cfm free air at 30 psi

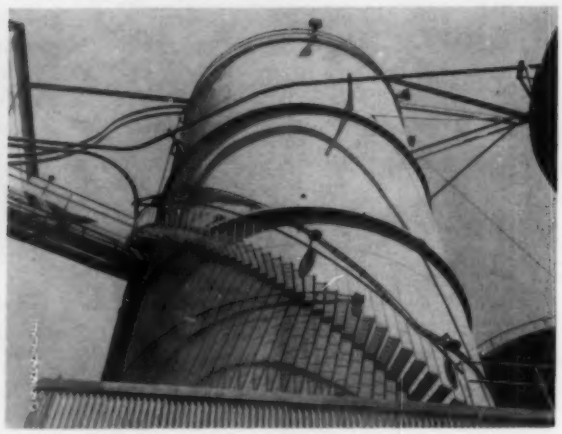


Fig. 5. 1000-ton silo stores bulk fly ash for shipment. Bagging machine, for 75- and 100-lb bags, is underneath silo

the center panel on which the functioning of the system is clearly indicated by means of colored lights. These lights indicate the exact status of each individual unit in the system.

Efficiency of this fly ash handling installation is obtained through utilization of low pressure air to fluidize the fly ash (60 lb per cu ft) and thus reduce its friction. This is applied in two ways: in the conveyors, where the fluidized fly ash loses its angle of repose and flows by gravity; and in the pump, where fluidization causes the fly ash to become aerated and thus pumpable.

Depending on the job to be done, either of these principles accomplishes the economical, high-capacity transport of the material. For simple transfer of fly ash from one collection point to another at a slightly lower level, the conveyor is the most obvious choice.

Thus, at the beginning point in the system, where the precipitator collecting hoppers accumulate the fly ash at very high temperatures and transport is required only to the surge hopper, Airslides are used.

At the bases of the collector hoppers are 14 by 14-in. manually-operated rotary vane feeders which permit gravity flow of the accumulated fly ash into the conveyor's material inlet.

An Airslide conveyor consists of parallel upper and lower chambers separated by gas-permeable refractory-type porous plates specially designed for handling very hot flue dust. Air under low pressure, which is passed from the lower chamber through the porous plates, partially fluidizes the fly ash, reducing its friction and giving it some of the characteristics of a liquid so that it flows by gravity on a slightly downward pitch.

In this manner, fly ash is transferred from the collection hoppers via another collecting conveyor (Fig. 3) to the surge hopper for the pumps.

Low pressure air for the conveyors is supplied by a fan-type blower through air lines connected at intervals to the lower chamber of the conveyor.

High-Capacity Pumps

Underneath the surge hopper into which the conveyors discharge fly ash are located two 6-in. Fuller-Kinyon pumps. These are connected to the surge hopper by a special two-way discharge gate which permits alternate operation of the pumps with one on stand-by. For three hours of each eight-hour shift, one of these pumps is in operation, pumping fly ash through a 5-in. line over a distance of 1000 feet.

The Fuller-Kinyon is essentially a dry solids pump and a pipeline. Fly ash from the surge hopper descends by gravity into a receiving hopper of the pump and is advanced through the barrel of the pump by an impeller screw. As the material advances, it is compacted — to prevent blowback — by the decreasing pitch of the screw flights and a variable space between the last screw flight and a check valve. The material then enters the mixing chamber through the check valve, where it is fluidized by compressed air from a series of air jets, and in this fluid state enters the pipeline. Here it is advanced as a dense column at a low velocity.

Compressed air for the pumps is supplied by two Fuller single stage rotary air compressors installed nearby. These compressors (Fig. 4) are of the rotary type and deliver a steady non-pulsating stream of air directly from their discharge ports to the air manifold of the pumps.

Each compressor is rated at 600 cfm of free air at 30 psi. They operate alternately since each supplies one of the pumps on alternate operation.

The most important feature of this type of pneumatic conveyor is that it can pump practically anywhere — around corners, vertically, horizontally and for long distances. Thus, the unit can be installed and operated wherever space exists to mount the pump and run a pipeline. Also, like the conveyor, it is a totally enclosed system from which no dust can escape. For materials such as fly ash, this is a vital point.

Fly Ash Has Commercial Value

Fly ash is a commercial commodity. In recent years, its value as a lightweight aggregate in the manufacture of concrete and bituminous products has become recognized and its use has steadily increased. More and more plants where fly ash was once a troublesome disposal problem now are finding that they can profitably resell it to a variety of outlets.

As an adjunct to their pneumatic system for efficiently handling fly ash, Commonwealth Edison has set up facilities for bagging and for bulk delivery. These facilities are also served by the Fuller-Kinyon system.

Fly ash is first pumped to a large silo located at the bagging plant. Underneath this silo, a bagging machine is located accommodating 75- and 100-lb bags. One man does all the bagging here and the filled bags are sorted for shipment.

When this bagging silo is full, the fly ash is pumped to a 1000-ton storage bin (Fig. 5) where it is stored until ready for shipment by truck. Both silo and bin receive fly ash pumped by the Fuller-Kinyon pumps. This operation is also controlled from the main control panel. THE END

Want Extra Pages of Articles?

No need to tear up your copy of POWER ENGINEERING. We'll be glad to furnish you extra pages of articles. Just write the Editor on your letterhead or use the enclosed post card, and jot down the title that interested you.

Silicon Rectifiers Prove Reliability in Unique Switchgear Control System

This novel dual-substation installation demonstrates numerous advantages over conventional a-c or d-c energy sources, saves space, maintenance, initial cost, and improves operating characteristics

By **JOHN A. GIENGER** *

SILICON RECTIFIERS, newest development in the conversion of alternating to direct current, will provide means of insuring continuity of critical processing for Eastman Kodak Company, in Kodak Park Works, Rochester, N. Y.

Installed in the transfer control circuit of a new dual substation, the rectifiers will provide control power to switch all load automatically to a second primary source in the event of failure of the first source.

First of its kind ever developed using silicon rectifiers, the new control arrangement resulted from extensive engineering development and coordination between engineers of Kodak and the manufacturers of the dual substation which incorporates the new transfer control.

Substation will supply power to a new multi-million dollar film manufacturing facility, scheduled to begin operation this year.

Two schemes have generally been used in the industry to supply control power to dual substations, the a-c scheme using transfer contactors and the d-c scheme using storage batteries. Major disadvantage of the a-c scheme is the three-cycle delay which will occur whenever the transfer contactors are required to operate. Major disadvantages of the battery scheme are the space occupied, maintenance, initial and replacement costs. The rectifier scheme used in this installation will function without the above disadvantages of either of the two schemes.

Installed in December 1957, the substation is now in partial operation supplying power for construction, but will soon supply full power for film manufacturing. After start-up, operations will be on an around-the-clock, seven-days-a-week basis — relying on prompt action of the transfer control to switch breakers and maintain power.

Background

Until now, the transfer control power has been supplied primarily by batteries. But it has been the desire of the switchgear industry through the years to develop a method that would eliminate the need for batteries, yet provide operating characteristics as near as possible to batteries.

In place of the battery-powered systems, an a-c automatic transfer control contactor and/or a-c voltage-chasing transfer control scheme can be used. These, however, tend to cause undesired voltage fluctuations or actual interruptions, in some instances, just when control power must be relied upon the most to transfer the main power source. This can result in fused circuit breaker contacts.

Now, silicon rectifiers have been developed sufficiently that they can be used to make possible, for the first time, a solidly connected rectified d-c secondary control bus whose primary may be two or more separate power sources.

Voltage of this d-c control is maintained automatically at the proper level, so that a primary transfer can be made just as long as only one of the two or more primary sources holds its voltage.

Competitive in price and proved conclusively by exhaustive tests, the silicon rectifier control scheme offers further significant advantages:

1. Requires less mounting space than that needed for a-c transfer contactor of same rating.
2. Eliminates need for maintenance of transfer contactor, and the adjustable "aging" resistors required with other rectifiers.
3. Permits use of solidly connected d-c secondary control bus to afford continually energized bus regardless of number or phase relationships of primary sources.
4. Permits use of standard rated coils, relays because a-c/d-c voltage drop is negligible.

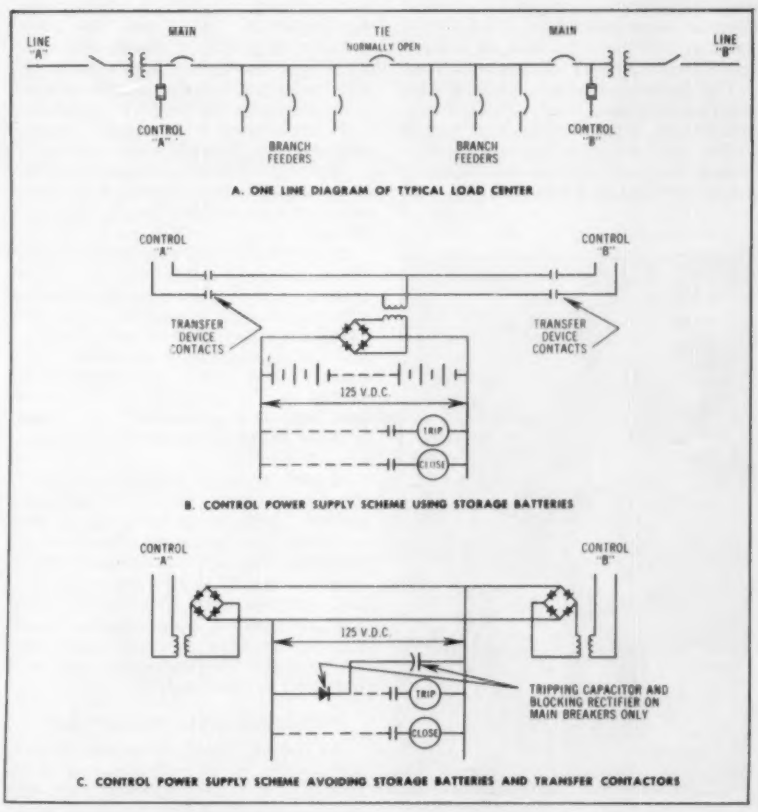


Fig. 1. Simplified circuit diagrams comparing the silicon-rectifier power supply with a conventional storage-battery source, charged through transfer contactors

* Electrical Engineering Consultant, Engineering Div, Kodak Park Works, Eastman Kodak Co

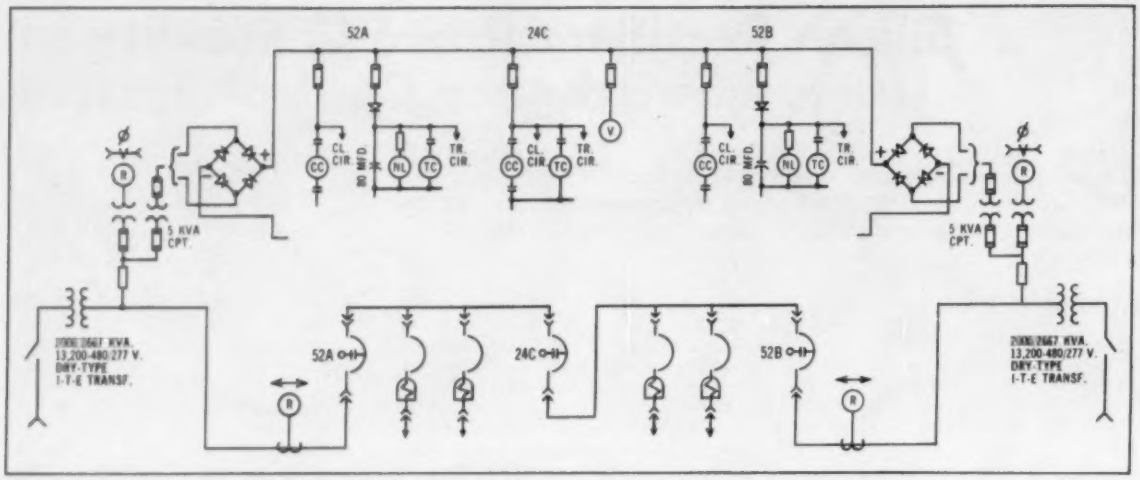


Fig. 2. Basic circuit diagram of rectifier control. For the first time, secondary can be solidly connected to both sources

5. Eliminates chance of feedback through rectifier when source is de-energized and preferred source secondary voltage relays are not required.

In critical processing operations where power must not fail, or thousands of dollars damage in lost production is the result, Kodak is quite aware of the need for safeguarding production by providing alternate sources of power. The company also is alert to economies that result from cutting the hidden costs of wasted space and excessive maintenance.

Until installation of this new dual substation with silicon rectifier transfer control, Kodak's dual substations relied on batteries for d-c control power. In addition to maintenance needs and aging problems, the batteries took up approximately 20 square feet of floor space — worth about $20 per square foot — which could have been used for manufacturing.

Operation

Many double-fed load centers are used at Kodak Park at critical locations where continuous power is required. During normal operation these centers function with the tie breaker open, Fig. 1A. If a power outage occurs on either end, the main breaker on that end opens automatically and the tie breaker closes to restore power. A voltage failure on both ends produces no breaker operation.

When sensing a bus fault — excessive current through a main breaker — with or without voltage on either end, the control opens the main breaker and keeps the tie breaker open.

This requires stored energy only for tripping the main breakers. There is no requirement for closing or opening with an outage on both ends, and operating practices preclude the possibility of energizing a shorted secondary bus directly by primary switching. For instance, with a faulted bus and the power off, the main breaker must be closed after the line switch.

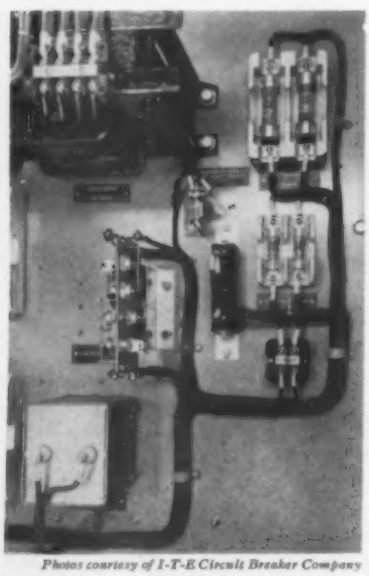
A control power supply system was developed to provide this type of operation, with substitution of silicon rectifiers for batteries, Fig. 1C. Its adoption did not appreciably affect interchangeability of devices or control schemes with those used in the battery-powered installations. Direct-current devices generally preferred are retained. Testing procedures were modified to some extent.

Tripping after Power Loss

In the new control system, Fig. 2, the closing power for main and tie breakers is taken directly from the control bus. Trip circuits of main and tie breakers also are energized directly from the control bus. The main breakers may be tripped at any time within approximately eight seconds after all primary power is removed, through use of the stored energy available across the trip circuit capacitor.

A neon indicating light, with negligible current drain, is inserted across this circuit to show that stored tripping energy is available. A "blocking" silicon rectifier is employed in one leg of the trip circuit, allowing current flow only in one direction. This prevents a reverse discharge of the tripping capacitor into the control circuit. A voltmeter provides indication that control voltage is available.

Primary-source phase-sequence and undervoltage relays are used to initiate transfer of the primary circuit breakers when necessary. THE END



Photos courtesy of I-T-E Circuit Breaker Company

Fig. 3. Heart of the system is the silicon rectifier, small unit left of center

Fig. 4. Here, the author checks a line power meter in the new dual substation

How Big A Boiler Feed Pump Motor?

Factors affecting the choice of motor size in driving boiler feed pumps are multiple and complex, author points out, but they are so important that they should be well known to every power engineer

By IGOR J. KARASSIK *

DESPITE THE RECENT resurgence of steam turbine drive for high-pressure boiler feed pumps and the equally recent introduction of main turbine-generator shaft drive, the motor-driven boiler feed pump still finds itself in the majority by a rather comfortable margin.

Because the size of the drive has grown rapidly with the increase in unit size and in operating pressures, greater attention than ever needs be directed at properly sizing the boiler feed pump motor.

On the surface, the problem of motor sizing would appear to be extremely simple and hardly a fit subject for detailed analysis. The operating conditions for the boiler feed pumps are selected, the brake-horsepower at the rated capacity determined and the motor size picked at the next larger standard rating. This has been and still is the method used by a great many steam power plant designers.

But even within the framework of a conservative approach to motor sizing, this does not necessarily answer to the true requirements of the situation. The rated capacity, total head and power consumption of a boiler feed pump are really of academic interest only, since they seldom represent conditions under actual operation. The total installed rated capacity for a given turbine-generator unit is selected on the basis of adding a specific margin to the maximum flow to the boiler.

This margin, which is intended to compensate for boiler swings and for pump wear, will vary between wide limits, which reflect the degree of optimism or pessimism of the engineer who prepares the pump specifications. Thus, the margin of capacity may range from a low of 6 per cent to a high of as much as 20 per cent.

Calculating Head Required

Rated total head is then selected by constructing the system-head against which the pump will operate. The required discharge pressure is established for a range of capacities up to the value of the installed rated capacity by adding the drum pressure, the economizer losses, the static head to the boiler drum, the losses through the feedwater regulator in wide open position and the various heater and piping friction losses.

Assuming that the pump takes its suction from a deaerating heater, the suction pressure for the same range of capacities will correspond to the heater pressure (which varies with the load) plus the static submergence to the pump centerline less the friction losses occurring in the suction piping.

Net pressure required to feed the boiler at various flows will then be the difference between the discharge pressure and the suction pressure. The total head will be the net pressure converted into feet of head, corrected for the corresponding specific gravity. The rated total head will be the system-head at the rated capacity. The rated power consumption will be the pump brake-horsepower corresponding to this rated head and capacity point.

Alternate Schemes

There are two different boiler feed pump arrangements used to serve today's steam power plant installations and they must be considered separately insofar as their effect on motor selection is concerned:

1. One so-called full-capacity pump is used to meet the full demand of the boiler. Its rated capacity and head, therefore, is determined as we have outlined above.

2. The full capacity requirements of the unit are met by two so-called half-capacity pumps, operating in parallel. Their rated capacity is selected as one-half of the previously established installed rated capacity. Their total head remains the same as in the case of the full-capacity pump, that is the head required at full rated capacity.

Difference between these two arrangements is that in the case of the first, the rated pump capacity will not be exceeded in operation, while in the second case, operation of a single pump under light load conditions may take place at flows in excess of the rated pump capacity and the maximum power consumption may in turn exceed that at the rated pump flow.

Typical Problem

Let us examine the effect of single pump operation with a numerical example. We shall assume that the maximum boiler demand of a given unit is 1,000,000 lb per hr, that the designer has chosen to add 10 per cent to this demand in establishing total installed pump capacity and that the conditions of service at the rated capacity and over a range of flows are those which are indicated on Table I.

It will be noted that the drum pressure at the rated pump flow of 1,100,000 lb per hr is the same as at the maximum boiler rating, since it is not expected that the turbine demand will exceed 1,000,000 lb per hr and therefore the losses between the boiler drum and the turbine throttle will not increase even if the flow *to* the boiler increases. The system-head curve calculated on Table I is plotted in Fig. 1.

If a single pump were selected to meet the unit requirements, it would be rated at 2430 gpm and 5375 ft. Assuming an efficiency of 78 per cent,

* Consulting Engineer and Assistant to Vice-President, Worthington Corp

ESTIMATED SYSTEM-HEAD REQUIREMENTS

Total Flow in 1000 lb per hr	500	600	700	800	1000	1100
Temp F	280	292	300	310	325	325
Spec Grav	0.93	0.923	0.92	0.914	0.906	0.906
Vapor Press, psig	34.5	44.5	52.3	63	81	81
Total Flow, gpm	1074	1300	1520	1750	2200	2430
Suction Pressure, psig	63.5	73.5	81	91	108.7	108.5
Discharge Pressure						
Drum Press, psig	1910	1925	1940	1955	2000	2000
Economizer, psi	8	12	16	21	33	40
Static, psi	50	50	50	50	50	50
FW Regulator (open), psi	15	23	30	40	62	75
Heater Friction, psi	5	7	10	13	20	25
Piping Losses, psi	5	7	10	13	20	25
Total Discharge Pressure, psig	1993	2024	2056	2092	2185	2215
Net Pressure, psi	1929.5	1950.5	1975	2001	2076.3	2106.5
Total Head, ft	4780	4890	4950	5065	5260	5375

Table I. Background information, typical boiler feed pump motor sizing problem

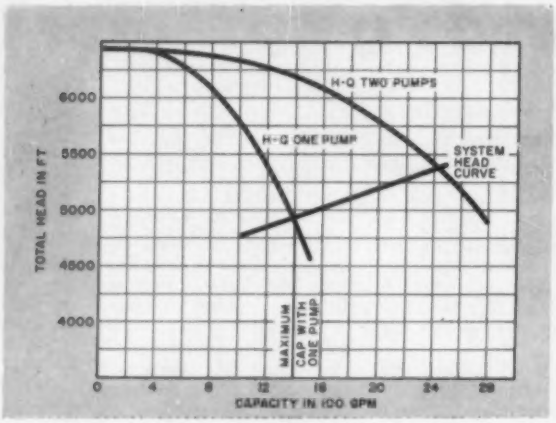


Fig. 1. System-head curve plotted from values in Table I

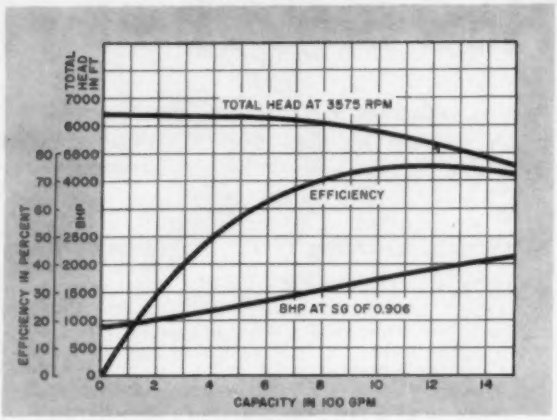


Fig. 2. Total head, efficiency and bhp plotted vs capacity

its power consumption at rated capacity would be 3830 bhp.

With two half-capacity pumps, they would be rated at 1215 gpm each, 5375 ft total head, 76 per cent efficiency and the power consumption at the rated flow would be 1970 bhp. The pump curve is illustrated on Fig. 2.

If we superimpose on the system-head curve shown on Fig. 1 the head-capacity curves of the single pump and of two pumps operating in parallel, we will see that while two pumps will intersect the system-head at 2430 gpm, the intersection of a single pump head-capacity curve will take place at 1400 gpm, in other words at a capacity in excess of the pump rated flow.

Referring to Table I, we see that the operating temperature at 1400 gpm is approximately 296 F, the specific gravity 0.921 and the flow expressed in lb per hr is 645,000. In other words, it is possible to deliver 64.5 per cent of maximum boiler demand with a single pump running. At this flow of 1400 gpm, the total head is 4925 ft, the efficiency 74.8 per cent and the power consumption 2145 bhp.

Final Decision

Should these half-capacity pumps be driven by 2000 or by 2250 hp motors? It is true that the rated power consumption is only 1970 bhp, but we have established that conditions may arise when the power consumption may reach 2145 bhp and thus exceed the nameplate rating of a 2000 hp motor by 7¼ per cent.

This is where the judgement and experience of the designing engineer enters into the picture.

Temptation to hold the size of the driving motor to the minimum reasonable value is a very real one. In the range of horsepowers encountered in boiler feed pump service, the cost of a 3600 rpm motor is about $21 per hp, not counting the cost of installation or of the starting equipment. Thus, in our particular case, and assuming that three pumps are to be installed (including one spare pump), the difference between using three 2250 or three 2000 hp motors, will be in the order of $16,000 and represents an increase of about 12.5 per cent of the total motor cost.

In considering the choice between two motor ratings, it is necessary to understand the manner in which motors are rated. Boiler feed pump squirrel cage induction motors are normally open drip-proof type, with Class A insulation and are rated as 40 C rise over a 40 C ambient, with a service factor of 1.15. This means that the motors are capable of carrying 115 per cent of rated load continuously in a 40 C ambient, or of carrying rated load continuously in a 50 C ambient without injurious heating.

Since 40 C corresponds to 104 F and since it is unlikely that this will be frequently exceeded in a steam power plant installation in the United States, there appears to be every reason to make use of the service factor of the motor for that period of pump operation when the use of a single pump will bring the bhp to 2145.

In other words, whenever two half-capacity pumps are used to supply the full demand of a unit, it is sound practice to determine the horsepower consumption under single pump operating conditions and if this falls within the service factor of the motor rating that would be selected for rated conditions, one should consider seriously taking advantage of this service factor.

Other Advantages

Savings in the cost of the motors are not the sole advantages that will accrue from following this practice. We have already mentioned that additional savings are available in the cost of installation and in that of the starting equipment.

We must remember that the motor starting current is entirely independent of the power requirement of the boiler feed pump at either full rated load or at any other operating condition. It is strictly a function of the motor nameplate rating. The normal type of motor used on boiler feed service has a starting current of 600 per cent of full rated load current. An unnecessarily oversize motor increases the starting current and places undesirable requirements on the installation.

Hydraulic Coupling Cost

There is one more advantage which may be available to the designer if the boiler feed pumps are to be operated at variable speed by placing a hydraulic coupling between the motor and the pump. The size of the hydraulic coupling to be used is dictated by the size of the driving motor. Thus, in some marginal cases, the unwarranted use of the next frame size in selecting the motor will in turn call for the use of the next size of hydraulic coupling, with a consequent increase in installed cost.

In order to evaluate this particular effect, reference is made to Table II which indicates the available ratings in hydraulic couplings, the corresponding maximum motor sizes and the price of each size of hydraulic coupling, at this writing.

In the particular case we have examined, the use of a 2250 hp motor would have forced us into applying size 198-A couplings instead of size 171-A, at an increase of $3800 per coupling, or $11,400 for three pumps. Coupled to the savings from using 2000 hp motors instead of 2250, this amounts to a total of $27,400 plus any savings in installation and starting equipment.

In some cases, these savings can be even more significant. Consider, for instance, an installation of three pumps which have a power consumption of 2900 hp at the rated capacity and, let us say, a maximum of 3250 hp when the pumps are operated singly.

Let us further assume that hydraulic couplings are to be used. A size 198-A coupling can be selected

if the motor is to be 3000 hp, but the use of a 3500 hp motor will carry with it the necessity of applying a size 212 hydraulic coupling.

Thus, applying a 3000 hp motor will save approximately $10,500 per motor and $16,900 per hydraulic coupling or a total of $82,200 for all three pumping units.

In the case of full-capacity boiler feed pumps there is, of course, no condition when they can be expected to operate at flows in excess of rated flows and, therefore with a power consumption in excess of rated bhp. Whether it is permissible to take advantage of the service factor in selecting the rating of the motor is a question which the power plant designer must decide after careful evaluation of all the inherent factors and of the available protective devices which can warn the operator that temperature rise is approaching the danger zone.

For there are such protective, or rather warning devices available. Detecting coils can be installed at a very small increase in price in the motor windings to provide an indication and a record of winding temperatures. These are resistance temperature detectors arranged to be connected with indicating and alarm instruments in the control room, so that the operators can observe motor temperatures and be warned adequately when they reach inappropriate values.

As a matter of fact, it is my personal belief that the proper manner in which large motors such as drive boiler feed pumps should be operated is on a temperature basis rather than strictly by nameplate rating.

There are of course circumstances under which the maximum calculated power consumption may be exceeded. There are also certain conditions when even this maximum calculated power consumption may lead to excessive temperature rise, even though it is suitable under normal conditions.

HYDRAULIC COUPLING RATINGS

Size	Maximum Motor Hp	Price in $
146	1000	10,300
171	1250	14,200
171-A	2000	19,800
198-A	3000	23,600
212	5000	40,500

Table II. Important effect of hydraulic coupling on selecting pump motor size

Without necessarily taking a partisan stand on this question, we may list some of the circumstances which — theoretically, at least — could lead to difficulties, especially if more than one were to arise simultaneously:

1. **Operation of the feed pumps at considerably lower temperatures than normal.** This circumstance is more likely to occur if the pumps operate in a closed feedwater cycle than if they take their suction from a deaerating heater. In the former case, we may have to consider the possibility of the closed heaters between the condensate and the main feed pumps being by-passed, and the feed pumps handling cold water with a higher specific gravity than normal. In the case of an open feedwater cycle, the supply of steam to the deaerator could hardly be expected to be cut off for more than a short period of time, during which the supply to the pumps would be drawn from the storage space at a temperature relatively close to normal.

Handling cold water increases the power consumption in direct proportion with the specific gravity. For instance, if the maximum power consumption were to have been based on handling 296 F feedwater with 0.921 specific gravity, this consumption will increase by about 8 per cent if the pumps handle cold water.

2. **Reduced voltage operation.** Operation of a motor under reduced voltage conditions has a very unfavorable effect on the available motor torque, the temperature rise and the maximum overload capacity of the motor. For instance, with 90 per cent rated voltage, the torque decreases by 19 per cent, the temperature rise increases by 6 to 7 C, and the maximum overload capacity decreases by 19 per cent.

Of course, there are many more factors which, to a lesser degree perhaps, but still to some extent, could introduce difficulties if they were to arise in an installation where some advantage had been taken of the normal service factor. But were we to assume that several of these unfavorable circumstances may arise simultaneously, we would be in effect trying to protect ourselves against a double or a triple contingency. Whether such protection is necessary and whether its added cost is justifiable will always depend upon the general philosophy followed by a particular owner.

Whatever this philosophy, it is important that the power plant designer first give full consideration to the correct method in establishing the maximum power consumption which can occur in a given installation, and that he be fully acquainted with the relative cost of following one or another method of selecting the size of the motors that will drive his boiler feed pumps. THE END

Aluminum-Bronze Fights Pump Corrosion

By JOHN W. FELTON *

ALUMINUM-BRONZE possesses outstanding qualities to meet the problems of erosion, corrosion and abrasion in pumps. Inherent difficulties in casting, machining and working the metal, together with limited knowledge of its properties, formerly made it valuable only where it offered proved advantages over other alloys.

However, improved techniques of molding, melting and pouring, now insure sound pressure castings, capable of working pressures to 2500 psi. These castings possess uniform density, high strength and require no heat treatment. Aluminum-bronze castings are smoother because an aluminum oxide "skin" envelops the entire casting when it is fluid, reducing the tendency to flow into crevices of the mold sand.

Adding carbon to iron in the correct proportion produces steels of hardness and toughness much greater than that of the base metal; alloying copper with aluminum produces a bronze with physical properties similar to steel. Mechanism of improving the properties of a base metal is generally believed to be as follows:

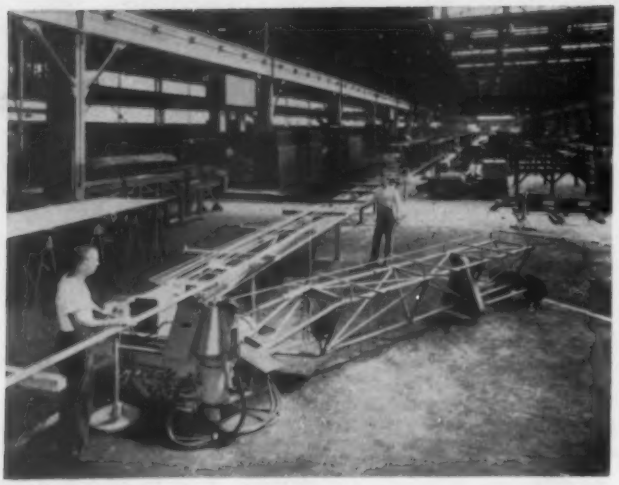
When one alloy element is added to a pure base metal, the "foreign" atoms find their way into the uniform crystals and distort them, destroying the regular planes and leaving the alloy with a random distribution of irregularly-shaped crystals. This makes for greater resistance to slip and a stronger bonding between particles. The alloy is hard and probably brittle. Addition of iron to the copper-aluminum alloy serves to reduce the hardness to a useful range and increases the ductility. The final product is aluminum-bronze.

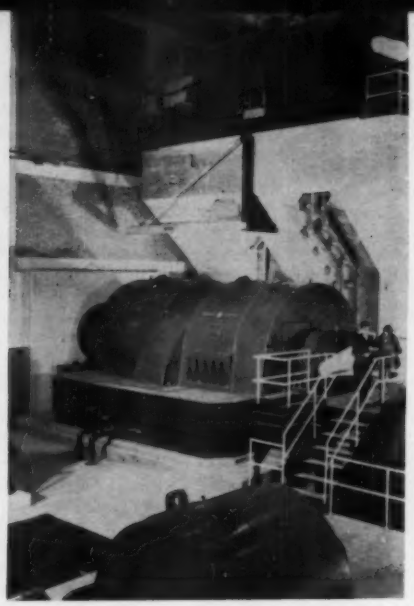
Toughness and hardness of the material combine to give a high degree of resistance to abrasion. Casing and impeller castings of this alloy provide a pump with excellent resistance to failure from attack by abrasives such as sand, salts and slurries and from attack by cavitation erosion.

Sea water, polluted harbor waters and commercial brines have been used in severe tests on aluminum-bronzes. These tests demonstrated superior corrosion and erosion resistance over many metals, including 18/8 steels, manganese-bronzes and chromium-nickel-irons. Of great importance is the economy of aluminum-bronze in these services.

Resistance to sulfuric acid over a wide range of concentration and temperature varies from excellent to poor. In general, at temperatures below boiling and concentration to 75 per cent, nickel-aluminum-bronze shows excellent resistance. Rate of attack may be increased by impurities and by aeration.

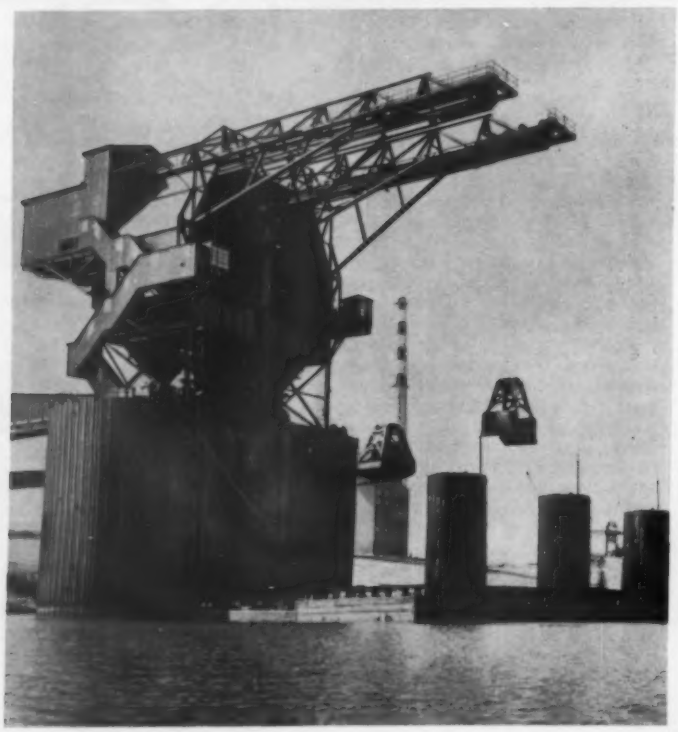
* Application Division-Engineering Department, Goulds Pumps, Inc



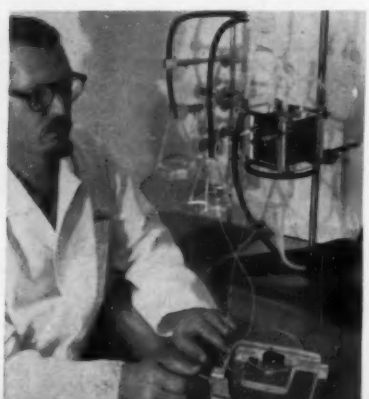


U-bend of heat exchanger tubes (above, left) can be done in straight lengths up to 75 ft by this machine now in use at Chase Brass & Copper Co. Two legs, one of which rotates through 180 deg, wrap the center around a die that forms a bend of the precise radius determined by tube gage and diam

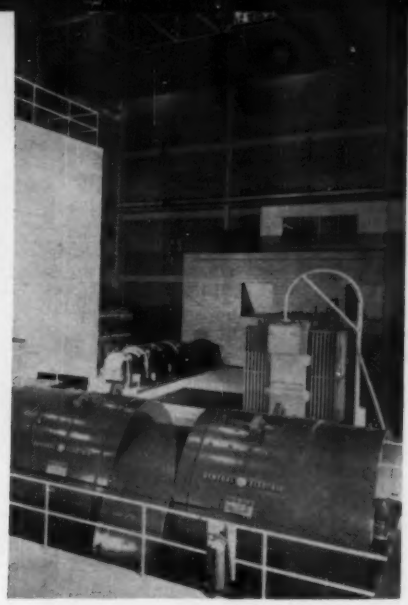
Portable island (left) is pushed by tug down Mississippi to New Orleans for first stop-over in 10,000-mile voyage to Persian Gulf. It will be used by Italian government for oil-drilling operations. Right photo shows machine under construction by LeTourneau. The three electrically-powered 120-ft legs raise and lower the platform at a rate of one foot per minute



Largest coal unloading tower is this one, just completed by Dravo Corp for the Thos. H. Allen Electric Generating Station in Memphis. Each bucket has capacity of 13.3 tons. **Below:** Lockheed Missiles work on fuel cells indicates cells powerful enough to power autos and even planes could be developed within 5 years

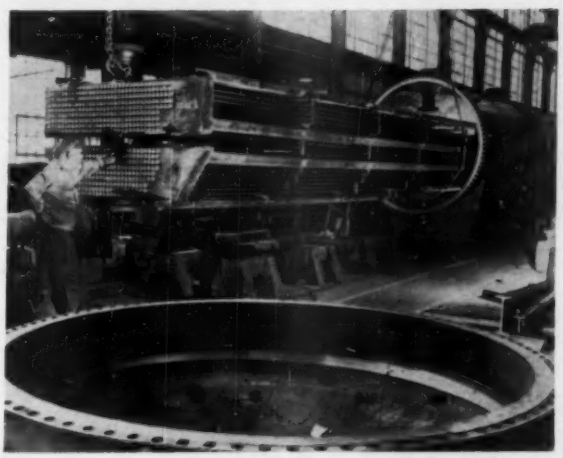


POWER ENGINEERING'S NEWS REEL

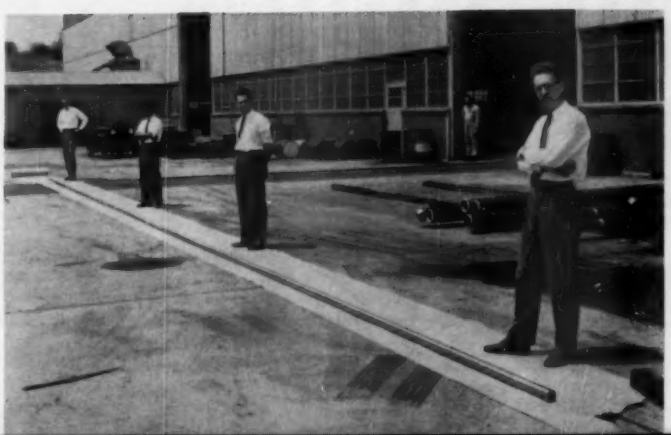


▲ **Reduced downtime** for maintenance is predicted for these double-armature 12,000-hp twin-drive G-E motors in operation at a slabbing mill. New "top-forward" arrangement allows extension shaft for motor on right to pass beneath motor at left. Also, bearings on both are easily accessible

Polyhedral hull of this new 30-passenger boat by Higgins, Inc, has "breaks" on the bottom which deflect the water, reducing skin friction and increasing speed. Built of non-corrosive Alcoa aluminum, boat is powered by two 500-hp Solar gas-turbine engines, has speeds in the 40-mph range. Engines deliver through reduction gears and V-drives to propellers at 1625 rpm



Self-scaling tube bundle is being inserted into a big Griscom-Russell Bentube evaporator. Three of these units, which exchange heat at a rate of about 24,500,000 Btu per hour, have been made for plants in the American Electric Power Co system. Each unit produces more than 28,000 lb per hr of vapor, with purity 1 ppm of dissolved solids



All zirconium and 57 ft long, this single section of tubing is reported to be the longest yet formed from that metal by a method used at Tube Reducing Corp. Zirconium stock was "rocked" and compression-formed in exactly the same way as for less-expensive metals. Entire I.D. area passed borescope inspection and did not require honing or re-work. Tube is to be used in atomic reactors

Here's how one utility company cut its accident frequency rate from 15.4 to a dramatically low 2.0. Enthusiasm and interest of top management, stimulation of individual responsibility, and a simple, commonsense booklet served as a magnet to attract the whole company to . . .

All Out For Complete Safety

By E. R. LEHMAN *

WE ARE PROUD of our safety record. Interstate Power Co — with 1,200 employees — serves 120,000 electric customers in 249 communities and rural areas in Northeastern Iowa, Southern Minnesota and Northwestern Illinois; plus some 30,000 gas customers, and the bus transportation in Dubuque, Iowa.

As shown on the graph below, our accident frequency rate for 12 years (from 1940 to 1951) ranged from 7.9 to 23.0, and averaged 15.4 for the 12 years. The national average for electric utilities ranged from 11.1 to 15.3 (for an average of 13.2) for the same period.

Such an accident record was not compatible with the fine improvements being made in other phases of operation, and management recognized that fact. They felt that Interstate employees were better-than-average; and, with proper guidance, could have a better-than-average accident record. They felt that management could, and should, provide that guidance, along with safe working conditions, and procedures, for its employees.

How was this to be accomplished? By hard work, and by genuine, continuing management, and employee, enthusiasm. A sincere desire by top management to spare the employees the suffering, heartaches and expenses of needless accidents was, without question, the motivation which made the improvement possible. That sincere desire was more than a willingness to approve expenditures and issue orders. It was a desire to also expend personal time and effort to satisfy that objective. That is what top management of Interstate Power Co was willing to do — and did do.

Plan of Attack

We realized that practically all accidents are caused by PEOPLE, and that if accidents were to be eliminated, it must be done by the rank-and-file of employees, and not by orders, directives, machines and safety devices and equipment.

The major factor in the success of Interstate's safety program was the approach to the problem. That approach was based on the premise that ALL EMPLOYEES ARE ABLE TO THINK, and if given an opportunity to exercise that power (and the responsibility which goes with it), they will react favorably.

In early 1952, top management put special emphasis on accident prevention. The importance was thoroughly emphasized at a Managers' meeting; all supervisory personnel were alerted to the fact that top management was concerned about the company's accident record, and that improvement was mandatory.

Special meetings of supervisory personnel were called in various districts, especially where accidents were particularly numerous, in an endeavor to find out what could be done to improve the situation. These meetings were called by the District Managers, and attended by the Executive-Assistant and Safety Director. Much was learned from these meetings; perhaps the most outstanding fact was that the safety rule book should be revised.

It was apparent that this was more of an excuse for a poor accident record, than a cause, inasmuch as it could not be proved that there was anything basically wrong with the book. However, it was quite old, and contained some rules which were not pertinent to modern day operations. Nevertheless, it was apparent that many employees were conscious of the antiquity of the old safety manual — in accident-prevention.

Also, it was found that supervisory personnel were quite apathetic to their responsibility in accident-prevention. There was a feeling that someone else had the problems of accident-victim medical care, authenticity of accidents, and corrective measures. Further, there was no direct effort to determine whether ailments were the result of accidents, or were the end result of non-occupational activities.

Specialists on Committee

A committee was appointed to revise the safety rule book; it consisted of the Safety Director, a Line Foreman, two Operating Superintendents, a Construction Engineer, and the Assistant to Production Engineer.

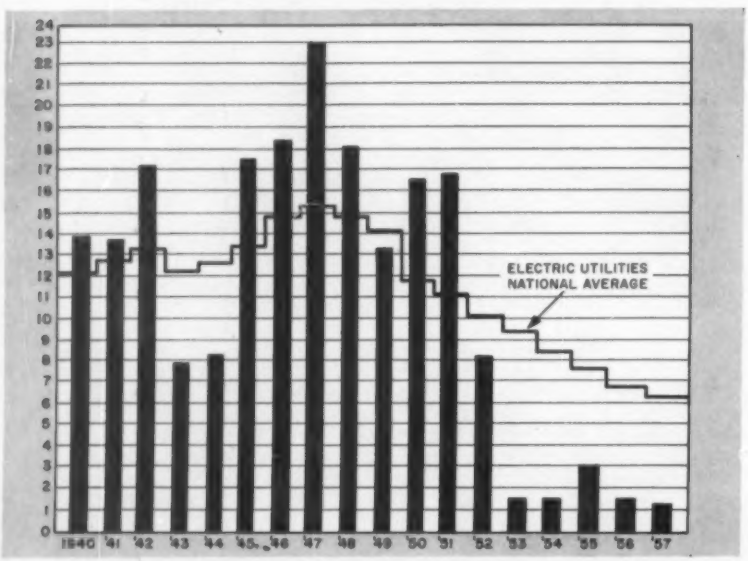


Fig. 1. Dramatic illustration of Interstate Power Co's drastic reduction in accident rate (First 10 months of 1958 indicate a frequency rate of 2.0 for the full year). Note the immediate reduction in frequency rate in 1952, and almost the equivalent in 1953. National average was declining also, but not to such great extent

* Safety Director, Interstate Power Co, Dubuque, Iowa.

All of these men had had years of operating experience and were familiar with problems encountered on the job.

The rule book in use at the time was a very conventional, and typical, safety rule book, containing over 500 RULES; it was very similar to rule books used by other utilities, but had not been revised for over 20 years. The committee spent a week analyzing rule books of other utilities, discussing our own problems, and drawing a draft of a new booklet to be called HOW TO WORK SAFELY. This was to be presented to management for approval, as a replacement of the conventional Safety Rule Book in use at the time.

After a month, in which each committee member had an opportunity to do more detail work on the booklet, another meeting was called, and the new booklet was completed in detail — and submitted to management for approval.

This new booklet as presented, and approved by Management, CONTAINED ONLY 45 RULES. They were very simple, and basic, rules of accident-prevention, and did not go into details. It did not contain a lot of DO'S and DON'TS, as most conventional rule books do, nor was it written in language hard to understand or interpret.

The new safety booklet was designed and written for the purpose of giving the employees a guide in the performance of their duties. Much is left to the good judgment of the individual, and it was certainly intended to be that way. Management of Interstate Power sincerely believes there is no substitute for common-sense and good judgment; to deprive the individual of the opportunity to exercise judgment is not conducive to improved operations, whether it be accident-prevention, or any other phase of the business.

This booklet is pocket size, printed in two colors; this adds a great deal to eye-appeal and to its ability to sell safety. It was distributed to all employees in November 1952. It has been well accepted by the employees and has been copied, in various degrees, by many other electric utility companies.

As evidence of acceptance by the employees, all were invited to submit suggestions for revision of the rules, and very few suggestions were received. The special committee then met, but made only minor changes.

Adoption of this new and unconventional Safety Booklet, incorporating the philosophy of allowing employees to think and exercise their judgment, has, without doubt, been a major factor in stimulating enthusiasm and contributing to the reduction in accidents.

Since early 1952, there has not been a Managers', Supervisory or employee meeting (attended by an executive of the company), where the executive has not emphasized the importance of accident-prevention.

Fig. 2. Celebrating 7-year record; left to right: Peterson-VP, Nâney-Ch El Eng, Lehman-Safety Dir, Galloway-Dist Oper Supt, Lyshoj-Dist Mgr, Hoksch-Ch Plt Engr

Management has expended the effort to let all know that they are sincerely interested in the welfare of the employees, and that the responsibility for a good safety record is directly on the shoulders of all supervisory personnel, as well as on the individual workman.

Also, since 1952, the District Managers, Operating Superintendents and Foremen have been called into the President's office to explain, and discuss with the top executives, every accident that has caused a fatality or serious injury to an employee. Every accident that is serious enough to cause loss of time is reported immediately by telephone to the Safety Director. Every employee, injured seriously enough to require medication, x-rays or professional services, is taken (not sent) to the doctor, or hospital, by his supervisor. This regulation promotes a highly personalized relationship, not otherwise attainable.

Great effort is made to generate enthusiasm and maintain active and continuous enthusiastic support for the safety program. Various District Managers have had dinners for the employees and wives, given awards (or both), after completion of a year without a disabling injury. Each award is imprinted with the occasion for the award and the individual's name. It is not a REWARD, and nothing has been promised. It is merely a token of appreciation for a job well done, and is entirely at the discretion of the various Managers. It is a part of the overall program of maintaining enthusiasm and safety-consciousness.

Management of Interstate Power Company believes that the employees are intelligent enough to carry on the operations of the Company in a safe manner. The problem is to keep them alert enough to take the time to think and plan each job, and realize the importance of guarding against possible hazards and human errors.

Results of the Program

Has this approach to the problem been successful? The accident-frequency chart attests to the effectiveness of the program. In 1953, for the first time, Interstate Power Co won first place award in the Public Utilities section, Group C, Combination Companies contest of National Safety Council. And, it has won first place for five consecutive years — 1953 to 1957. THE COMPANY'S FREQUENCY RATE WAS 2.0 FOR THE FIRST 10 MONTHS OF 1958.

In addition to the reduction in employee injuries and suffering, the program has been a major factor in reducing Public Liability accidents, and in creating better employee, and public-relations. It has been a contributing factor in the general overall improvements that have earned respect for Interstate Power Co.

Editor's note: We believe one of the most effective items in the company's safety booklet is the creation of PRIMARY AREAS, which are described as ANY AREAS FROM WHICH A WORKMAN CAN REACH, SLIP OR FALL INTO ANY CONDUCTOR OR EQUIPMENT ENERGIZED AT MORE THAN 300 VOLTS. Such primary areas require protective equipment. THE END

Want Extra Pages of Articles?

No need to tear up your copy of POWER ENGINEERING. We'll be glad to furnish you extra pages of articles. Just write the Editor on your letterhead or use the enclosed post card, and jot down the title that interested you.

From This Warhorse . . . . . to 11 million lbs steam per day, 2000 tons refrigeration, and 3500 kw is . . . .

Pasco Packing's Power Story

By JAMES M. WILLIAMS *

WORLD'S LARGEST single citrus processing plant, Pasco Packing Co, is located in the eastern part of Pasco County just north of Dade City, Florida. Company started in 1936 as a fresh fruit packing plant and has since progressed through the steps of experimentation and development to the point where it now processes all fruit received into concentrate, single-strength juice, sections, dried cattle feed, citrus molasses, peel oil and terpine oil.

Pasco processes oranges, grapefruit and tangerines after proper grading by squeezing out the juice and then treating it so that it can be either pasteurized and canned as single-strength juice, or sent to evaporators where it can be evaporated down to citrus juice concentrate under sterile conditions of low temperature and high vacuum. After this, it is sent to cold-wall tanks where it is blended with pulpy juice and lowered to a temperature of approximately 50 F. Finished concentrate is then pumped through votators where the temperature is again reduced to about 20 F and sent to closing machines where the cans are filled, sealed and frozen. After casing, the product is maintained at −15 F until shipped out in refrigerated railroad cars or trucks.

How a Giant Grew

One major indication of the tremendous growth of Pasco Packing is the change in process requirements for steam, refrigeration and power for the entire operation.

First steam boiler to be installed was the small 1.5 hp unit now exhibited atop the visitors' assembly building. From this meagre beginning has grown a steam plant that now totals 13,000 hp and is capable of producing 11 million pounds of steam per day. Main power plant today consists of five boilers ranging in capacity from 20,000 to 160,000 lbs per hour. All have automatic combustion controls and CO_2 recorders, as well as the necessary steam flow meters for accurate accounting purposes.

Burners in all boilers are the steam-atomizing type. Fuel is No. 6 oil which is received by truck and stored in a 250,000 gallon tank.

Power from Process Steam

Saturated steam is generated at 180 psi and distributed to our turbine-generators for generation of electric energy. Exhaust from these machines is then sent throughout the plant for use in process. This steam is used in equipment sterilizers, in a steam-jet refrigeration unit and in steam boosters and jet air ejectors to produce low vacuum for the evaporation processes.

Electric generating plant consists of one old 1000 kw back-pressure machine and a new 1500 kw back-pressure unit. An old condensing machine is held in reserve as emergency power in the event of failure of our utility source.

Process Means High Make-Up

Problems of make-up water to our boilers is an important one inasmuch as the make-up rate is approximately 60 per cent. This amount of condensate is lost due to contamination in the various processes.

Original softener installation in 1946 was a conventional hot process lime-soda unit with supplemental phosphate being fed into the feedwater line. As capacity grew, however, softener capacity had to grow as well. First modification to the original system was to convert the old hot-process unit to a second-stage phosphate softener, and to build a new and larger first-stage. This was adequate for a time, but as more boiler capacity was added, it was decided to add three ion-exchange units.

Our refrigeration system has grown from an original ammonia unit with capacity of 300 tons to the present 2000 tons. Our Freon system has increased from the original 20 tons to a present capacity of 600 tons. One development resulting from this tremendous increase was the incorporation within the system of an automatic controller to step-up or step-down different pairs of compressors to give us any stage of capacity from 35 tons (two-stage) to 260 tons.

How Refrigeration Load Grew

In 1946 our total refrigeration consisted of two 15 in. by 10 in. booster compressors and two 10 in. by 10 in. high-pressure compressors. These four units handled the requirements of one cold room, 146 ft by 150 ft, as well as an air-blast freezing tunnel which was used to freeze polyethylene pouches of concentrate and outside products such as shrimp. Cold room temperature is maintained by water-defrost type coils. Cold air is circulated through ducts to louvered air distributors to product spaces and back to the coils.

As production increased on a continuing basis since 1947 it has been necessary, since that time, to add one cold room of 170 ft by 204 ft, and four additional cold rooms, each 132 ft by 182 ft. It was also determined early in this period that available equipment for quick-freezing of concentrate was inadequate. After thorough investigation it was decided to install a methanol-brine spray system. A tunnel, 110 ft long by 20 ft wide, was constructed that contained four 4 ft LaPorte mats running the full length and returning underneath.

To handle this substantial block of

---

* Steam and Refrigeration Engineer, Pasco Packing Co

load, we installed a centrifugal machine rated at 232 tons of refrigeration and driven by a 700 hp electric motor. This is a complete and compact unit through which we circulate 1200 gpm of methanol and 1200 gpm of condenser water.

Comparison of Refrigerants

Both ammonia and Freon is represented in our plant and we are in an excellent position to compare them. Both have their advantages and disadvantages. For large industrial installations, we prefer ammonia because the cycle is better; also, leaks are easier to find. Main disadvantage is the fact ammonia is dangerous to personnel in event of a bad leak.

Freon has the advantage of being non-toxic. One of its disadvantages, however, is the fact it is possible to develop a leak and lose a valuable amount of refrigerant before the leak can be detected and repaired. Too, in a centrifugal Freon compressor there is fairly low efficiency. We get only 232 tons of refrigeration (at −40 F suction temperature) with 700 hp, whereas with ammonia in a two-stage system, we get approximately the same tonnage with 500 hp. Freon centrifugal compressors have fewer moving parts and less wear, since there is less vibration and there are no suction or discharge valves to give trouble. Seals and bearings are the only sources of trouble, and under normal conditions these parts should last for many seasons of operation.

Ammonia compressors which we have installed are not too difficult to maintain in operating condition if we can keep a fairly dry suction gas. Whenever suction traps or interstage coolers do not function properly, however, we encounter trouble resulting from liquid slop-over. For the first few years after we installed the original ammonia equipment we did not have a suction trap and we were constantly replacing broken valves caused by this slop-over.

An Ideal Maintenance Set-up

Since our plant operation is seasonal we have found that most of our repair and preventive maintenance can be accomplished during the summer shut-down period. In this period we keep only sufficient compressors running to keep the cold rooms and stored product cold. During this shutdown we open all compressors, inspect all valves and replace any found broken or badly worn. We also clean out all crankcases and inspect all bearings, replacing as necessary. Oil filters and lubricators are filled with new oil. All motors are cleaned and lubricated at this time. In the event of failure of any of the equipment during the operating season, we have sufficient reserve capacity to permit us to proceed with necessary repairs immediately so that the machinery can be returned to operation without loss of production. Machinery which is run continuously for six months collects quite a bit of crankcase sludge, and for this reason we have found that compressors should be opened in the middle of the operating season and their bases cleaned.

Maintenance work on boilers, turbines, water treating equipment, steam and water lines and all valves is also performed during summer shutdown. Immediately after the plant has ceased operation we cool and open the boilers; wash the drums and tubes. A high-pressure spray is all that is required to remove the light sludge coating the drums and tubes, since our water treatment program has proved very effective.

All valve stems are cleaned and new packing installed. Valves are inspected and either replaced, ground or sent out for repair.

Heavy Duty Means Heavy Repair

When boiler furnaces have cooled sufficiently, we remove bad refractory and replace with new material. Amount of this type work which we have will invariably depend on the manner in which we have fired the boilers during the operating season. When we have to run some of the boilers at maximum capacity for extended periods (as in case of an emergency), we can be assured of some extensive furnace repairs.

Water-cooled condensers are opened and the tubes scraped and brushed to remove accumulated sludge and scale. In addition to this, we have found it advisable to acid-clean all such equipment after a season when we have had to operate the plant at high loads.

Some Pointers From Experience

As every plant has its difficulties, so have we had ours. Some of our faults we have corrected. With the hope that our experiences may help others, we make the following recommendations:

1. Every large refrigeration system should have installed suction traps to catch any liquid slop-over and protect the compressors from damage.

2. All cold rooms should have as few openings as possible. They should have the best vapor seal obtainable on the outer surface of the insulation. Cold rooms should also be provided with some means of floor heating (utilizing some fluid material which won't freeze) at a depth of approximately three feet below the insulation. Floor insulation should be of such load-bearing material that moisture and temperature change will not affect it.

3. All plants should have sufficient stand-by equipment to handle full load (steam, refrigeration, electrical) so that in the event of shutdown of any component due to mechanical failure, production can be maintained while repairs are effected.

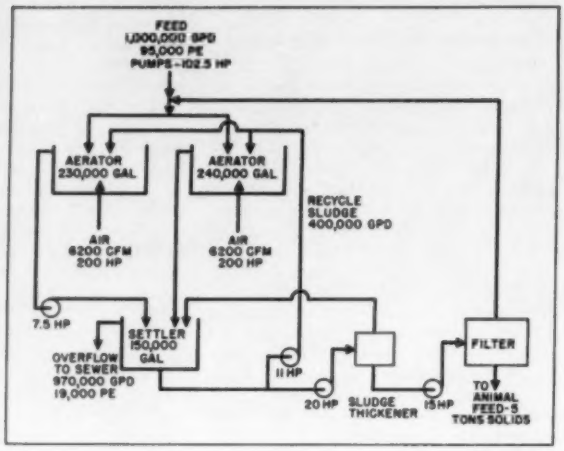
4. In order to operate at peak efficiency at all times, all systems using alcohol, glycol and similar substances should have sufficient distilling or concentrating equipment to handle maximum demands of the plant at full load.

5. All boiler plants should maintain regular schedules of water sampling and treating in accordance with their needs, to be assured of good boiler feed make-up. Only in this manner can boilers be kept clean so that they will always be operating most efficiently.

6. All large commercial refrigerating systems should have an automatic air purge to keep system free of non-condensible gases and maintain head pressures as low as possible for optimum efficiency. THE END.

Power requirements of this sprawling giant have grown fantastically since 1946

Figs. 1 and 2. View of one of the aeration basins of the submerged culture plant, showing the airlifts and impingement nozzles. Reaeration of the sludge is accomplished in the basin at the left. The process uses 556 hp, much of it in the 200 hp blowers indicated in the flowsheet of Fig. 2



Staley Saves Water, Cuts Process Waste

Two new ideas—a submerged culture process and a cooling tower that purifies—are helping this corn wet-milling plant to hold loss of valuable ingredients to the sewer, to 1.0—1.5 P.E. per bushel

By J. C. REYNOLDS * and R. J. MAUTERER *

PLANT OF THE A. E. Staley Mfg Co at Decatur, Illinois, employs a process, typical of the corn wet-milling industry, to produce a wide variety of products including starch, syrup, animal feeds, oil and special products. The plant is located on a 380-acre tract and employs about 3000 persons. Over 60,000 bushels of corn are processed each day to produce about 600 tons starch, 350 tons syrup, 450 tons animal feed and 50 tons of corn oil as the major products. At the same location over 50,000 bushels of soybeans are processed each day using a hexane extraction method.

Daily some 4,000,000 gallons of water are filtered and 1400 tons of coal burned; a large portion of each is required for the power station, which produces about 20,000,000 lb of steam. The power plant includes two 6000-kw turbines and one 2500-kw turbine, and another 7500-kw turbine will shortly be in operation. In addition, about 10,000 kw is purchased.

Nature of the Problem

As its name implies, the corn wet-milling process incorporates a water medium, and rates up to 2000 gpm are common. In its infancy, the industry was interested only in the recovery of its prime product, starch, and the remaining corn ingredients were largely ignored and wasted. Excessive quantities of fresh water were used, and those streams containing small quantities of product were sewered. Thus low yields of about 75 per cent were typical, while the tremendous sewer losses tended to create serious water problems for municipalities.

Since then, the program for recovery of valuable products through the reduction of sewer losses has raised the yield to about 99.5 per cent. One large step forward in this recovery program was the adoption of the so-called "bottled-up" process. Through various means of clarification, or solids removal, a given quantity of water can be used over and over again for several process steps. Therefore the amount of fresh water which must be added to the process is kept to a minimum. This resulted in considerable reduction in the volume of solids-bearing water wasted to the sewer and allowed the industry to increase valuable yield.

Subsequent varied improvements further reduced losses to the range of one to two "population equivalents" (P.E.) per bushel of corn processed. Then a plant which processes 60,000 bushels of corn per day is able to hold its losses to between 60,000 P.E. and 120,000 P.E. per day. This is equivalent (in sewage strength) to the waste of a city with a population of 60,000 to 120,000. In most cases these losses represent the 0.5 per cent of yield diluted to the point where conventional means of recovery are not economically sound.

In recent years progress and expansion have been most rapid in the industry, and have resulted in an ever-increasing number of specialty starches and other new products. In many cases, these — by their very nature — present difficult recovery problems which require individual attention and solution. Thus the control of plant losses has grown to be one of the major problems of plant operation.

At the Decatur plant the struggle is a continuous one, under the full-time supervision of a chemical engineer who is also charged with the improvement of existing recovery methods and the initiation of new processes for individual recovery problems. The system of control involves the metering and sampling of all streams having access to the sanitary sewer and of other streams which have an indirect effect on losses. Daily accounting procedures

* Chemical Engineer, A. E. Staley Manufacturing Co

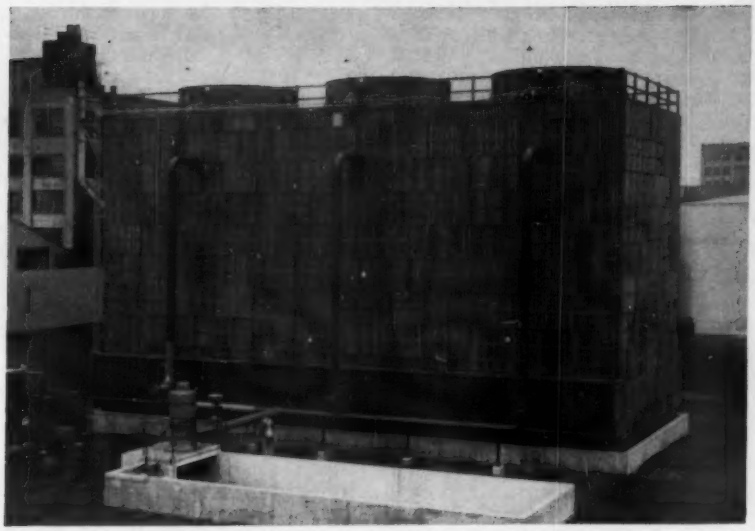


Fig. 3. View of the three-section cooling tower showing the mixing basin in foreground. The Dowpac HCS packing is in the section at right. Fungus grows on packing

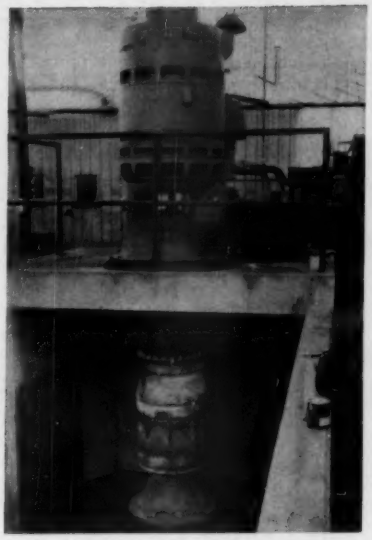


Fig. 4. Vertical turbine pump moves water from mixing basin to the tower

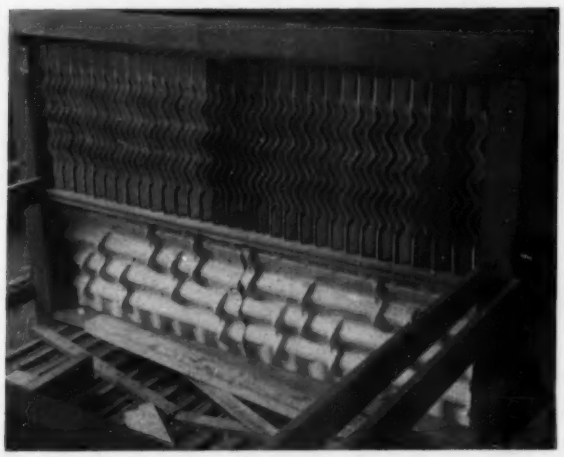


Fig. 5. Side view of the Dowpac HCS packing used in the cooling tower. Excess amount of caustic is used to clean packing

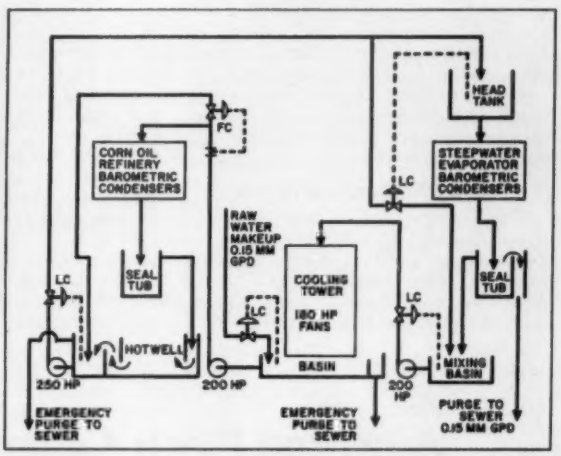


Fig. 6. Schematic of the cooling tower system. Flow control (FC) maintains a constant flow from the cooling tower basin

provide information which is then used by operating personnel for loss control.

Effluent from the Staley plant discharges into the sanitary sewer which conveys it to the Decatur Sanitary District. There it is treated along with the city wastes, and the purified water discharges to the small Sangamon River. For the Sanitary District's services, the Staley Co is billed on the basis of volume, dry solids, and sewage strength. The Staley Co has for years enjoyed the coöperation and assistance of the Sanitary District personnel. This excellent relationship has been mutually beneficial.

Submerged Culture Plant

As new products were more and more frequently introduced, it became apparent that a major step was necessary to keep losses within the tolerable limit. Accordingly investigations were started in 1952 which finally resulted in the installation in 1955 of the submerged culture process.

This is essentially a method for recovering about 50 per cent of the corn-source soluble solids. The process is one in which microbiological organisms are used to destroy about one-half the organic wastes in the presence of oxygen, and is successful because it is effective in very dilute streams. Fortunately the combination of waste streams fed the plant provides a healthy environment for the micro-organism, that is, a good balance of protein, carbohydrates, and minerals. Had this not been the case, it would have been necessary to supply artificially the required ingredient, such as ammonium phosphate for nitrogen and/or phosphorus.

It is to be emphasized that this plant received only corn-source wastes and not other wastes. The process was expanded of necessity in 1957 to double its former capacity. It is now capable of handling 1,000,000 gallons per day of waste streams, representing a sewage strength of 95,000 P.E. The effluent is reduced to 19,000 P.E. for an efficiency of 80 per cent. About 5 tons of solids are recovered each day.

The process employs a total of 556 hp including the various pumps supplying the raw feed to the submerged culture plant. Referring to the accompanying flowsheet, Fig. 2, it can be seen that a major portion of the power is required by the blowers (200 hp each) which deliver 6200 cfm air to each of the two aerators.

The dilute waste-bearing streams are mixed and fed directly to the aerator tanks where the mixture contacts the microbiological organisms in the presence of air.

The air is introduced through nozzle assemblies which disperse and bring the air into intimate contact with the waste and the organism. The organism ingests the waste as food, exhaling carbon dioxide. The effluent from the aerators is routed to the 50-ft diameter settler where the organism settles and the purified water overflows to the sanitary sewer. The settled organisms are then routed back to the aerators to ingest new food.

However, in order to keep the population of the organism at the desired level, a portion is withdrawn from the system, thickened, filtered, and then dried as a portion of the animal feed product known as "gluten feed."

This portion represents roughly 50 per cent by weight of the organic solids in the raw feed to the aerators. Control of the system is maintained by 1. supplying just enough air to satisfy the requirements of the organisms; 2. retaining just enough of the organism in the system to ingest the waste food supplied; and 3. avoiding extreme fluctuations in pH, input volume and solids, and quality (that is, balance of protein, carbohydrate, etc) of solids.

Purifying Cooling Tower

Part of the water pumped from Lake Decatur to the Staley plant is returned to the lake reservoir. This returned water is cooling water used in surface condensers and is therefore free of contamination. Control of the net withdrawal from the lake is necessary in order to maintain adequate water storage and is of mutual concern to the city of Decatur and to the Staley Co. It was apparent in 1956 that further expansion of the corn plant would involve cooling water requirements beyond tolerable limits. A further limitation was imposed by the capacity of the Staley pumping facilities on Lake Decatur.

It was also apparent that the most promising area for water conservation within the plant involved the barometric condensers on the corn oil refinery deodorizers and on evaporators concentrating corn solubles. This cooling water is contaminated by corn-source wastes due to entrainment from the vacuum equipment into the barometric condensers.

At the same time, the Dow Chemical Co started production of a material called Dowpac HCS which is a polystyrene molded into corrugated sheets. These sheets can be packed closely together and can serve as a cooling tower packing.

Enough of this material was obtained by Staley to build an experimental forced draft tower 3 by 3 by 14 ft, with the hope that the packing would serve both as a cooling tower packing and as a surface upon which a microbiological sludge would grow and thus purify the water. Organic "entrainment" was artificially supplied the tower. The critical factor here was the natural and continual removal of the excess sludge from the packing; otherwise the packing would eventually foul to the point where cooling efficiency was nil. Study of the small tower resulted in good cooling efficiency, admirable purification, and insignificant fouling.

Accordingly, the needs of the plant were satisfied in 1958 with the construction of a three-section tower, 32 by 74 ft overall. Two sections employ common redwood packing and the third, Dowpac HCS. This tower has reduced raw water pumpage and net withdrawal by some 4,000,000 gpd, and has removed some 15,000 P.E. per day.

A fungus growth which clings tenaciously to the tower packing was found to grow well in the acid waters circulated in the tower. This led to excessive tower fouling. However, with the pH of the circulated waters in the neutral to slightly basic range, fouling was markedly reduced. Continuous pH control is now maintained with the addition of caustic. In addition, the system is treated with an excess amount of caustic once per month to further clean the tower packing.

Referring to the flowsheet of Fig. 6, it will be seen that the tower received 120 F water at the rate of 7.0 million gpd and cools it to 85 F (summer conditions). This water is routed to the very high vacuum barometrics in the corn oil refinery, which discharge at about 98 F. It is then pumped to the relatively low-vacuum (24-in. HG) barometrics in the corn-soluble evaporator station which in turn discharges back to the tower. A raw water make-up and a system purge rate of about 150,000 gpd each is maintained.

Major operating cost for this system is the power required for pumping the water about within the system. A total of 830 hp is involved, including the three ID fans moving about 230,000 cfm air through each section of the tower. THE END

American Power Conference Meets March 31-April 2

NEARLY 90 papers will be presented at 27 technical sessions scheduled for the 21st annual American Power Conference to be held at the Hotel Sherman, Chicago, Ill., from March 31 through April 2.

Eight sessions will be devoted to the mechanical aspects of power generation and eight to electrical aspects, according to Conference Director R. A. Budenholzer, professor of mechanical engineering at Illinois Institute of Technology, which sponsors the conference.

In addition, there will be two sessions on nuclear power, two on hydroelectric power, five on water technology, one on space heating, and one general session, Budenholzer said.

Three luncheons, and an All-Engineers dinner on April 1, will complete the three-day program.

Session topics include central station steam generators, operating experience with once-through boilers, large steam turbines, central station power plants, nuclear power plants, peaking service, industrial power plants, hydroelectric power, and water technology.

Others are feedwater circuit, fuels, space heating, extra high voltage transmission, cables, circuit breakers, incremental loading, network analyzers, distribution systems and industrial power systems.

Speaking at the opening general session on March 31 will be W. F. Rockwell, Jr, president, Rockwell Manufacturing Co, and Murray Joslin, vice president, Commonwealth Edison Co.

Luncheon speakers will include J. W. Corette, president, Edison Electric Institute, and Dr. Earl L. Butz, dean of agriculture, Purdue University.

Herbert D. Vogel, chairman of the board of the Tennessee Valley Authority, will address the All-Engineers dinner on the evening of April 1.

The conference is conducted with the coöperation of a group of educational institutions and technical societies. These colleges and universities are Illinois, Iowa, Iowa State, Michigan, Michigan State, Northwestern, Purdue, Minnesota, Wisconsin, Texas A. & M., New York, California Institute of Technology, Georgia Institute of Technology, and Massachusetts Institute of Technology.

The societies are American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Institute of Mining, Metallurgical and Petroleum Engineers, American Society of Civil Engineers, American Society of Heating and Air Conditioning Engineers, American Society of Mechanical Engineers, National Association of Power Engineers, Western Society of Engineers, and Engineers' Society of Milwaukee.

ASME Reports Power Field Progress

At 1958 Annual Meeting, power engineers discuss use of models in furnace design, advances in steam generation, steam and gas turbines, water treatment, nuclear energy, computers and control equipment; general developments in other phases of power also covered

Fig. 1. J. N. Landis, 1958 ASME president (left) and O. B. Schier, ASME Secretary (center) welcome the incoming 1959 president Glenn B. Warren

Fig. 2. L. F. Deming, Bureau of Yards & Docks of the Navy, was chairman of a session on fuels-power, corrosion and deposits—in fuel-burning equipment

Fig. 3. At a Fuels-Power Session, H. J. Rose, BCR, discussed forms of sulfur in coal; also problems and economics of reducing them to a reasonable limit

ADVANCES in every phase of power engineering were explained and discussed at the 1958 annual meeting of the American Society of Mechanical Engineers in New York, November 30 to December 5, 1958. Here are highlights of the discussions.

Some physiochemical aspects of supercritical water were explained. One engineer, speaking on thermiatrics, the diseases of high-temperature boilers, discussed the role of heat in these diseases and gave an explanation of the spontaneous growth of iron oxide in regions of high heat transfer. Others reported on the uses of certain organic acids for dissolving iron oxides and for other uses in power plant equipment.

Interesting symposium on furnace and burner model testing showed how flow models were used to aid in design of a furnace for a specific unit. It gave details of the use of scale models in developing pulverized coal burners and on the correlation between models and full-sized burners.

Some important details of the coal preparation processes and the methods of removing sulphur from coal and the economic problems of such coal cleaning were covered. There were common-sense approaches to the most frequent problems in trouble-shooting mechanical dust collectors.

At the Fuels-Power Luncheon, Fig. 5. Sporn pointed out that a world-wide reappraisal of nuclear power has been taking place during the past year or two, and, as a result of this, conventional fuel technology is receiving renewed interest and attention throughout the world. Gas Turbine Power Division sessions and nuclear sessions are reported elsewhere in this issue.

One symposium dealt with the requirements of flame failure protection, equipment available, and methods of incorporating it with boiler controls and combustion safeguards for coal, oil and gas.

In selecting industrial sites, a location where both electric and steam service can be made available by an electric utility may be a prime factor in the final decision. Quality of the service and attractive rates can also be important. Use of a computer in analyzing effective steam turbine reheat on speed governor performance was discussed, also application of computers to industrial power plants, emphasizing especially the need for preparing a program for the heat balance of a small station. However, as contrasted with computer programming, one speaker presented a method for solution of steam power plant heat balances without using the computer.

Initial operating experiences with monotube once-through boilers at subcritical pressures were given. The thermal performance of the Philo

Fig. 4. General view of one of the many technical sessions covering all phases of the power field. All sessions were filled to capacity and there was much discussion from floor

Fig. 5. At Fuels-Power luncheon, l to r, O. B. Schier, V. F. Estcourt (PG&E), F. P. Fairchild (PSE&G), Philip Sporn (A E P), speaker, and J. C. McCabe (Editor Combustion), chairman

supercritical unit was analyzed, and a combined steam gas turbine cycle to burn coal in an unusual way was reported.

Other subjects discussed were shot cleaning of air heaters, economizers and boilers; comparison of cross and counter-flow cooling towers; and considerations in application of hydraulic couplings for boiler feed pump drives. The hydraulic division heard much discussion of pump turbines, various features of new hydroelectric plants, measurements of water flow and details of construction of hydraulic equipment.

Relations between design of process equipment and power facilities for industrial plants were presented by typical examples, with a discussion of power performance standards to reduce manufacturing costs. Utilization of waste heat in industry was also treated in detail.

In a paper on fuel cells, speakers showed that high output fuel cells can be devised which give a thermal efficiency of 70 per cent for generation of electric power from fossil fuels.

Several papers on engineers as administrators were presented. There was a panel and group discussion on assets and liabilities of engineers, adaptability and specialization, the three latter directed specifically at junior ASME members. An interesting paper by Phelps, Director of the Engineering Societies Library, described the services of the library, and showed how information can be obtained from it.

There was the usual program of activities for the womans' auxiliary. There were inspection trips to various industrial and utility plants. At the annual banquet the incoming president Glenn B. Warren, was introduced, see Fig 1. Various honors and medals were conferred upon outstanding members of the Society for outstanding achievement. THE END

1958 New York Power Show

THOUSANDS of power engineers flocked into the great new coliseum at Columbus Circle in New York City, from December 1 to 5, to see the attractive displays of power equipment in the beautifully-lighted and well-organized New York Power Show, officially the 23rd National Exposition of Power and Mechanical Engineering. Over 250 manufacturers of equipment were represented. There were fully automatic package boiler units, complete with combustion controls, and one equipped with the new BCR stoker previously described in these columns. There was a display of a full-sized completely automatic water tube package unit of 20,000 lb per hr capacity, also several small high pressure once-through boilers for small users were displayed. Several exhibits featured equipment for the nuclear energy industry.

There were exhibits of electrical equipment and engine-driven generators, including a small portable gas turbine generator. Some motor generator sets for operating 400 cycle and other frequency tools were displayed. There was a wide array of instruments and control equipment, telemetering and supervisory systems and combustion and positioning electronic controls. Highlighting the control application was a receiving station that logged hourly operations of a large central station in upper New York State, the first live demonstration of generating station performance ever exhibited. It monitors and logs hourly 382 variables and tape punches 66 items per hour. Another exhibitor showed devices claimed to be capable of completely automating a power plant system.

An unusual new device was a motor-actuated pipe support, designed to relieve heat stresses in high-pressure pipe lines through a motor-driven jack that raises or lowers the support through a very small displacement in response to an automatic sensing device.

Many types of insulation, such as calcium silicate, insulation jacketed in aluminum, fiberglas-reinforced resins, a pipe and block insulation of diatamaceous earth, mineral asbestos fibers and lime, and several other types, were on display.

In small-sized motors, complete sealing of the stator with durable epoxy resin and, in larger sizes, with a silicone rubber insulation, were demonstrated.

One of the unusual exhibits was the model of a hyperbolic natural-draft cooling tower of reinforced concrete, as previously described in these pages.

Largest piece of equipment exhibited was a spherical-head type feedwater heater, 38 ft. long, weighing nearly 20 tons and having a capacity of 5,000,000 gpd of water.

Several exhibits of portable electric and air operated tools and of standard and special machine tools were of much interest to many of the engineers attending. Many of these tools can be used in power engineering maintenance work. THE END

Fig. 1. At the 1958 New York Power Show, there was always a good crowd around the exhibit of low-temperature welding technique and other maintenance tools shown

Fig. 2. General view down one of the aisles of the 1958 Power Show, where a wide variety of power equipment was displayed to interested engineers, like one in foreground

CONSTRUCTION NEWS

Corona, Calif. — State Division of Architecture, 1120 N Street, Sacramento, Calif., has authorized plans for a large laundry addition and related facilities at the California Institution for Women State Department Corrections, located here. Work will get under way soon on new laundry addition to cost about $175,000. A new boiler installation with auxiliary equipment is planned at an estimated cost of $80,000.

San Francisco, Calif. — Pacific Gas & Electric Co, 245 Market Street, has announced that company has asked the California Public Utilities Commission for permission to construct a 12,500 kw geothermal steam-electric generating plant at the Geysers, located in northern California's Conoma County. New plant, if approved, will generate electricity, using the natural steam piped from wells to company turbines. Company expects to invest approximately $2-million in new facility and related transmission equipment. Tentative plans for completion are scheduled for the spring of 1960.

Idaho Falls, Ida. — Atomic Energy Commission, Idaho Operations Office, has authorized contract award to the Fluor Corporation, Ltd, Los Angeles, Calif., to design and erect a waste calcination system at National Reactor Testing Station at Arco, Ida., near here. Work will get under way at once for scheduled completion by late February 1960. Cost when completed reported to be in excess of $3,300,000.

Lincoln, Ill. — Central Illinois Electric & Gas Co, Scully Building, this city has authorized plans for the construction of new substation and transmission line expansion of companies distributing facilities from New Holland to Lincoln and Highways 66 and 121 northwest of the city. Work is already under way for completion by early 1960. Cost of substation installation and line extensions reported to be about $670,000.

Fort Wayne, Ind. — Board of Public Works, City Hall, has authorized an expansion and improvement program in municipal power plant including increased generating capacity and plant and system improvements to cost about $4,000,000. Emery, Marker & Campbell, Toledo, O., is consulting engineer of the project.

Rushville, Ind. — Rushville Utility Service Board, has announced contract award to the Henry Vogt Machine Co, Louisville, Ky., to furnish and install a complete steam generating unit in municipal power plant here. Work on the new installation will begin at once for completion sometime in mid-1960. Size of installation not available; it is reported to cost in excess of $204,000.

Montezuma, Iowa — Board of Trustees, Municipal Light & Power Department, this city, has awarded contract in the amount of $99,000, for the installation of a 1050–1200 kw diesel engine generating unit at municipal power plant. Work will begin at once for completion by early 1960. R. W. Hughes Co, Omaha, Neb. has been awarded the construction contract.

Ottumwa, Iowa — Ralston Purina Co, 835 S. 8th Street, St. Louis, Mo., has announced contract award to the Tunicliff-MacDonald Co, Davenport, Iowa in the amount of $350,000. Plans call for the erection of a large chow mill, administration offices, boiler room and warehouse. Work will get under way at once for completion by the fall of this year.

Newark, N. J. — Public Service Electric & Gas Co, 80 Park Place, has announced that it proposes to build what is described as the first all aluminum transmission towers in the country. A recent statement by both the utility company and the Aluminum Company of America, Pittsburgh, Pa., announced that the utility company would use over sixty such towers on an 11-mile double circuit line it has under consideration from Hillsboro, N. J. to North Branch, N. J. Construction of the new line is planned for the fall of 1960, pending results of a test tower that Alcoa is to erect. When completed in the summer of 1961, it will be the first such installation in the United States.

Ossining, N. Y. — State Department of Public Works, State Office Building, Albany, N. Y., has announced contract award in the amount of $198,825 to the Landolfe Electric Corp, Mt. Vernon, N. Y., for construction and electrical work in connection with new substation and service connection at power house at Sing Sing Prison located here. Work is partially under way and scheduled for completion by late 1959.

Andarko, Okla. — City Council, City Hall, has approved plans for expansion and improvement in municipal electric power plant, including increased generating capacity. City has authorized bond issue in the amount of $650,000, to cover cost of expansion. Rea Engineering Co, Oklahoma City, Okla., is consulting engineer.

Philadelphia, Pa. — More than fifty private utility companies, headed by Philadelphia Electric Co, 1000 Chestnut Street, this city, have proposed a plan to the Atomic Energy Commission, for the construction of a nuclear power plant in this vicinity with an initial capacity of 40,000 kw which would provide a short cut to economical atom-fired electricity. Newly formed utility group to be known as the High Temperature Reactor Development Associates, Inc, has also proposed that the AEC provide $14,500,000 for research and development costs of the proposed plant. The utility group in turn would provide about $24,500,000 for construction of the plant. Philadelphia Electric Co would assume most of the cost involved since it would own the plant and use the electricity produced.

Conway, S. C. — South Carolina Public Service Authority has plans under consideration for the construction of a $36,000,000, steam-electric generating station here, as part of the state-owned Santee-Cooper electric project. New Plant reported to have an expected annual capacity of a billion kilowatt hours, will serve over 100,000 farmers through rural electrical cooperative companies in 27 counties of the State. Construction of the new facility is expected to begin later this year.

Hondo, Texas — Medina Electric Cooperative, has authorized plans for expansion and improvements in electric distribution system. Company plans to erect a new substation at a cost in excess of $150,000, along with improvements and additions to distribution lines serving the Hondo area in Medina County at an additional cost of about $95,000. Work already under way is scheduled for completion by the spring of 1960.

Lubbock, Texas — Texas Technological College, located here, has authorized plans for the construction of new boiler house and boiler installation on college grounds. Plans call for the construction of a large concrete boiler house to house a 1,000 hp boiler at a total cost reported to be $250,000. Plans for the building are being prepared by De Witt & Maeker, this city. Work, including expansion of chemical engineering facilities and science addition will get under way soon. Chemical engineering expansion and installation of a new nuclear reactor along with the science addition will amount to additional expenditure in excess of $1,100,000.

Murray, Utah — Murray City Council, City Hall, has approved plans for expansion and improvements in municipal electric power plant, with installation of a new 2500 kw dual fuel turbine generator unit along with auxiliary equipment. Work will get under way soon at a cost estimated to be about $551,000 and is under direction by Ray P. Greenwood, Mayor.

Cougar, Wash. — Pacific Power & Light Co, Public Service Building, Portland, Oregon, has announced completion of Swift Dam, on the Lewis River, the highest earth-filled hydro-electric dam in the world, to-date. The $56,000,000 dam project, located 35-miles east of Woodland in the foothills of the Cascade Mountains, is 512 ft high, has a base a third of a mile at the bottom and a crest 2100 ft in length. Generation of power will begin as soon as the 12-mile lake reaches operation level, when the power station will have an installed capacity of 250,000 kw.

Renton, Wash. — Puget Sound Power & Light Co, Stuart Building, Seattle, Wash., has plans under consideration for the construction of a large receiving substation on large site here to serve the Bellevue area. Work on the new installation with a capacity of 250,000 kva will begin early in 1960. Cost reported to be in excess of $3,750,000

Take Care of That Impeller!

Chapter 4 in a series on proper maintenance procedures for centrifugal pumps

By J. A. CABLE and O. M. KRISTY, Jr*

YOUR PUMP'S IMPELLER deserves the best of care, for the impeller is the work horse of any pump. In fact, if the impeller doesn't work, the pump can't.

Make sure you buy the right kind in the first place. Basically there are two types: open (Fig. 1) and enclosed (Fig. 2). There is also a differentiation between single and double suction, but this is usually decided for you, according to the type of pump which best fits your rating requirements. However, many pump types can be fitted with open or enclosed impellers, and you want the right one for your service.

It's easiest to rule this way: if one of the following conditions is to be met, ask for open impellers; otherwise the enclosed type should be used. So ask for open impellers if:

1. Pump is very small and to make an enclosed impeller casting just isn't practical.

2. Pumping large solids which will break up into smaller pieces when manipulated. For example, if making a solution by adding powder to liquid, the lumps which might form can be broken up by tumbling, through the agitation action of an open impeller turning close to a stationary side plate. These lumps could plug a closed impeller.

3. Material pumped tends to separate out and deposit on all exposed surfaces. An open impeller will be about 50 per cent self-cleaning in these services, while the coating can eventually plug a closed impeller; and when a coating does form, even on the open impeller's inner surfaces it can easily be cleaned out.

Don't use open impellers just because you are handling a slurry. Entrained solids in suspension can be handled in enclosed impellers more efficiently and with better maintenance records. Secret lies not in impeller choice but in wearing ring design. This will be explored further in our next chapter, which will discuss wearing rings.

If you have a pump with the right impeller, one main factor in getting a job out of it is to be sure it rotates in the proper direction. Somewhere on the outside of the casing there is a direction arrow. Be sure to check for correct rotation initially and any time after that when motor leads are disturbed. A centrifugal pump impeller turning backwards will give partial performance, but at great sacrifice in efficiency. So if the pump's only doing a half job but is overloading the motor, check rotation.

Even when handling clean water, an impeller can rapidly wear out if the pump selection did not properly consider the suction condition limiting factors. You often "hear" this wear before you see it, as the pump is downright noisy and sounds as if it were handling gravel or rocks. This wear is called pitting and results from the action called cavitation. Figure 3 shows what can happen.

* Application Engineer and Supervisory Engineer, respectively, Centrifugal Pump Dept, Allis-Chalmers Mfg Co

fold along this line—outside edges toward you

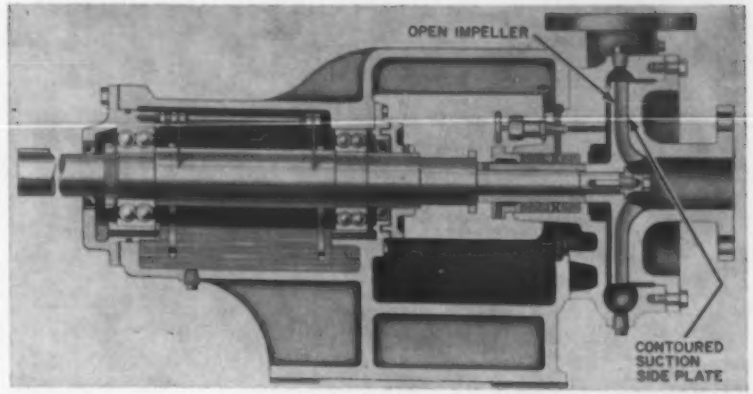


Fig. 1. Typical open impeller in single suction pump. Be sure that the impeller rotates in the right direction

Cavitation and Pitting

If you have this trouble, it can only be corrected by raising the water level in the suction supply or lowering the pump. Temporary relief can be gained by throttling the pump flow on the discharge side of the pump until the noisy operation ceases.

If the output in this throttled condition is sufficient for duty, recheck requirements against the pump curves. You've probably over-safety-factored and can cure the problem by getting the pump supplier to tell you to what smaller diameter you should remachine the impeller. If none of this works, you may have to buy a new pump, either larger or operating at a slow speed.

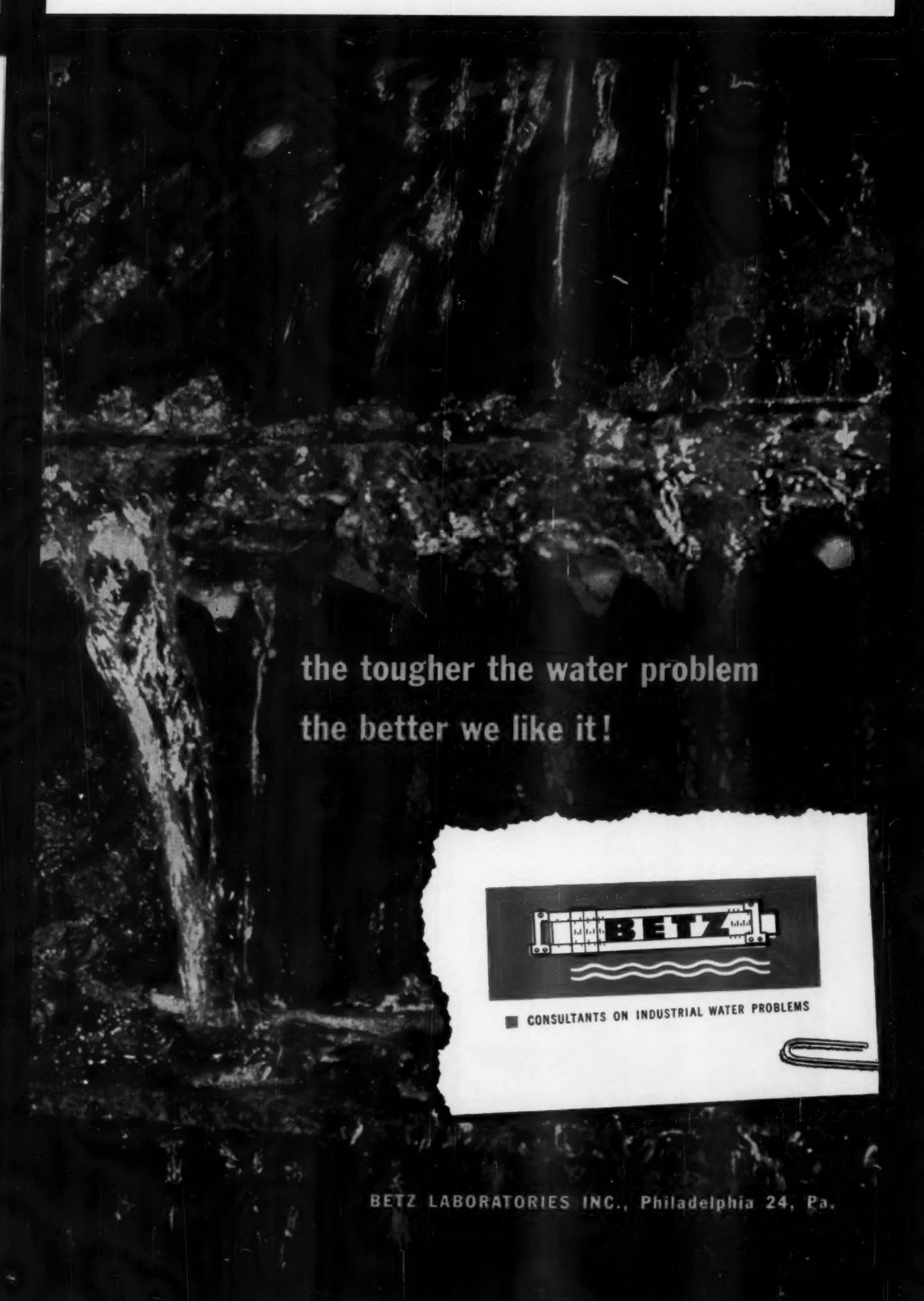
Because so many factors can enter into this suction problem, pump experts lump them all together into NPSH (Net Positive Suction Head above vapor pressure). At sea level, with cold water supplied at a level equal to the pump centerline, 34-ft NPSH is available. The amount pumps require is determined by test.

Theoretically perfect pump would have no entrance losses and could operate with

Fig. 2. Typical enclosed impeller for double suction pump. When should this type be used?

0 NPSH. In reality, general-purpose pumps' average requirements run 15- to 20-ft NPSH required. If you're pumping cold water, this means that at sea level you could lift 34 − 15 = 19 to 34 − 20 = 14 ft. Every pump has its own limits, which the supplier will state for you, so if you give him all the facts when buying a pump, you can avoid this trouble before it starts.

Cavitation and the resulting pitting are the penalty for border-line misapplication and can often occur even with


the tougher the water problem
the better we like it!
BETZ
CONSULTANTS ON INDUSTRIAL WATER PROBLEMS
BETZ LABORATORIES INC., Philadelphia 24, Pa.

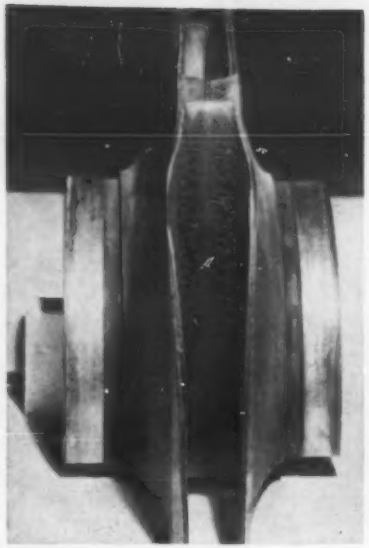


Fig. 3. Impeller damaged by cavitation pitting

positive suction heads with high temperature volatile liquids. If the pump is installed with actual suction lift, and NPSH is improperly considered, it will start after priming but will continuously lose its prime. If the trouble shows up in this manner, the same solutions as listed above for rapidly pitting impellers can be used.

Normal wear in a good pump properly applied will affect the impeller very slowly. Most good pumps have renewable rings to repair worn clearances. When a pump is down for other repairs it is well to wire-brush all the accessible impeller passages and check to be sure no foreign matter is plugged between vanes.

If you eventually have to replace an impeller, check its location before removing it, and put the new one in the same place so that it is centrally located in its respective casing volute and will rotate in the right direction. Multistage pumps with single suction impellers are right and left hand, so be especially careful to put them back properly.

Next Month — Wearing Rings

Watch That Motor Greasing Job!

FORCING an excessive quantity of grease into the bearing housing of rotating machinery is often the cause of derangements in electric motors and generators, the *Bureau of Ships Journal* reminds us.

Motors and generators provided with bearings that should be lubricated with grease are now normally delivered from the manufacturer with the grease cups removed from the bearing housings and replaced with pipe plugs. The grease cups are delivered with the onboard repair parts or special tools.

They should be attached to electric motors and generators *only* when the bearings are being greased. Grease should be added by responsible maintenance personnel using a grease cup. A grease gun should not be used to lubricate bearings unless no other means are available.

If the gun must be used, remove the drain plug in the bearing housing while greasing and use extreme care to avoid inserting too much grease or applying more than just enough pressure to get the grease into the housing.

Relating Cost of Heat to Boiler-Turbine Efficiencies

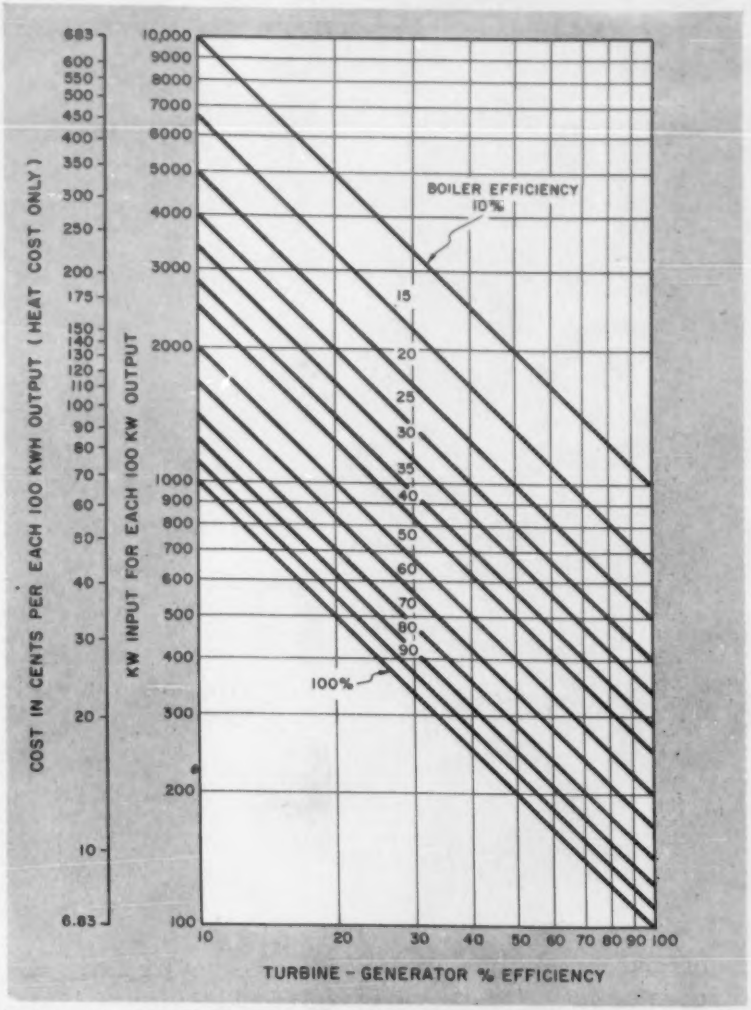
By NORTON SAVAGE, P.E.

CHART shown opposite presents a set of curves which show variation of heat cost with boiler and turbine efficiencies. Plotted as straight lines the curves represent the equation for overall efficiency of two devices in tandem:

$$(\text{Heat}) \text{ in} = \frac{(\text{Heat}) \text{ out}}{(\text{Eff.})_1 \times (\text{Eff.})_2}$$

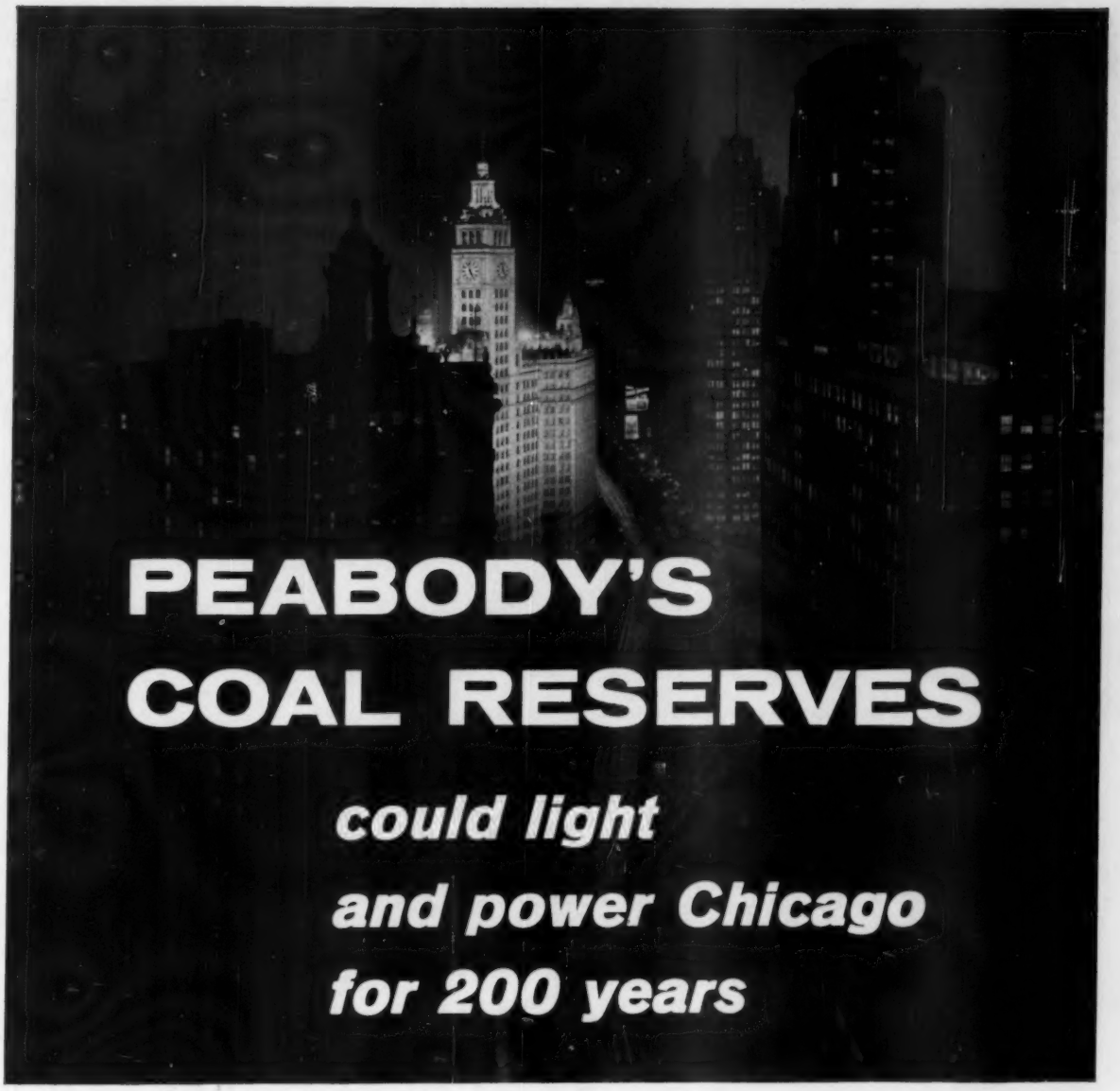
These curves could equally well be applied to an engine-pump combination, or any combination of two items which receive kw or Btu input and have an output measureable in kw or kwh.

fold along this line—outside edges toward you



Variation of heat cost with boiler and turbine efficiency. 1 kw = 56.89 Btu/min = 3413.4 Btu/hr. At 20 cents per million Btu, 1 kwh costs 0.068268 cents. Curves apply equally well to an engine-pump

To convert the cost scale to some base cost other than 20 cents per million Btu, say K, multiply the given cost scale by K/20. Result will be the cost in cents per each 100 kwh output, based on a cost of K cents per million Btu.



PEABODY'S COAL RESERVES

could light and power Chicago for 200 years

It takes a lot of electrical energy to light and power a modern city, and it takes millions of tons of coal to generate that electricity. That's why many of the nation's major electric utilities and large industries depend on PEABODY Coal. Long-term contracts assure them a dependable fuel source, backed by PEABODY'S two billion tons of proven reserves. And PEABODY'S ultramodern mining, processing and shipping equipment is geared to provide this coal "tailor-made" for their particular needs . . . efficiently and economically. If this is the fuel service YOU need, check with PEABODY first!

Get your free booklet, "This Is Peabody Coal Company", and learn more facts about PEABODY and its complete coal service. Write Department PE.

power for progress

PEABODY COAL COMPANY

Peabody Plaza, 301 Olive Street, St. Louis 2, Missouri

GENERAL OFFICES: PEABODY PLAZA, ST. LOUIS. OFFICES IN: CHICAGO, DES MOINES, KANSAS CITY, LOUISVILLE, MEMPHIS, MINNEAPOLIS, NASHVILLE

For more data circle 547 on Post Card

Fig. 1. Here insulating cement is being applied to exterior of bricks which line boiler waterwall

Fig. 2. Boiler hot air ducts get finish layer of insulating cement reinforced with wire mesh

Versatile Cements Solve Many Kinds of Power Plant Insulating Problems

By THOMAS J. CALLANS*

INSULATING cements are often taken for granted by most power engineers. Probably everyone is familiar with them, and uses them in some manner, but few take full advantage of the exceptional versatility and usefulness of these plastic insulating materials. They are capable of a variety of insulating tasks, especially in areas where insulation is often neglected either because it seems unimportant or because it is difficult to apply. An insulating cement used as an all-purpose insulation can simplify many maintenance material inventory problems.

There are three basic types of cements used to insulate heated equipment. They are commonly known as insulating cement, finishing cement and combination insulating-finishing cement.

Insulating cement is the best insulator of the three. Finishing cement is not really an insulating material at all, but merely provides an attractive smooth-finished surface for other insulating materials, often insulating cement. The newer dual-purpose insulating-finishing cement combines insulating qualities with a hard white finish and is often used as a step-saver in place of the other two types.

Insulating Cement

Insulating cement is probably most used to fill joints and voids and to level the surface of other insulating materials. It is also used as a complete insulation on small equipment and on curved and irregular surfaces, such as those of valves and fittings, which would be difficult to insulate with non-plastic insulations. It is also useful for patching or repairing damaged insulation easily, quickly and effectively.

The properties of a typical insulating cement are: 1. low thermal conductivity (k) factors range from 0.57 at 200 F to 0.83 at 800 F; 2. high maximum temperature (1800 F); 3. high coverage (45 sq ft, ½-in. thick per 50 lb) with low shrinkage (2 per cent at 1800 F); 4. reusability if not heated over 1200 F. (Specific values refer to No. 1 Cement, a mineral wool cement made by the author's company.)

Major limitations of insulating cements are that they often require wire mesh or metal fabric reinforcement or else must be applied in relatively thin layers. In addition, they usually require finishing. Finishing cement, canvas or metal jackets, and asphalt mastic are typical finishing materials.

*National Manager, Field Engineering Industrial Products, Baldwin-Hill Co

fold along this line—outside edges toward you

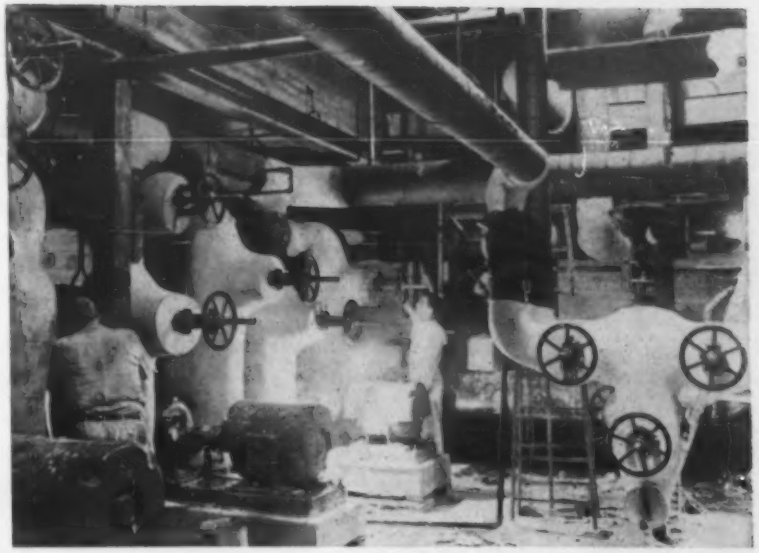


Fig. 3. In this boiler room, valves, tees and ells are covered with insulating cement and white canvas

Insulating-Finishing Cement

Because of their ability both to insulate and finish in a single layer, the combination cements are being used more and more in place of separate insulating and finishing cements. Although their insulating value is not up to that of the single-purpose insulating cement, this combination cement has definite insulating value, as shown in the following list of the properties of a typical brand (specific values are for Super Powerhouse Cement made by the author's company):

1. Thermal conductivity (k) factor of 0.70 at 200 F and 0.92 at 600 F.
2. Maximum temperature (1200 F).
3. Good coverage (36 sq ft, ¼-in. thick per 50 lb) with negligible shrinkage.
4. Initial set within 2 hr (after which it cannot be washed off by rain).

In addition, insulating-finishing cement needs no reinforcing materials on small surface areas. The higher thermal conductivity of insulating-finishing cements is not a limiting factor in applications where surface temperatures are low, such as when the material is applied over other insulating materials. In general, it is used for the same insulating jobs as plain insulating cement. However, it is particularly prized where a good finished appearance is desired without extra application steps.

In the New Narbonne High School Heating System...

GILSULATE®-protected underground pipe carries 232° F-water 14,000 feet

Built on a 40-acre campus, the New Narbonne High School in Los Angeles has complete educational and recreational facilities for 2,000 pupils; including 5 academic structures, 3 shops, 2 gyms, library, multi-purpose building, auditorium, and buildings for science, music, art and home-making, driver education, agriculture and administration. Architects and engineers: Daniel, Mann, Johnson & Mendenhall.

The heating system is an important feature of the attractive and functionally-efficient New Narbonne High School in Los Angeles. One central boiler plant with four low pressure boilers, hot water converters and pumps, supplies heat for all 19 buildings.

The distribution system—of all-welded pipe with necessary expansion loops—is laid in a 7,000-foot-long trench skirting the spiral shape of the building formation. Buildings are connected to the mains by reverse return systems running along the outside perimeter of each building, and heat from forced air ventilators can be regulated by individual room controls.

All underground piping is insulated with GILSULATE, Type A. So effective is this easily-installed, economical insulation material that during the curing process, prior to placing the system in operation, hot water, with an input temperature of 232°F was circulated through approximately 14,000 feet of pipe and returned to the boiler plant at 226°F...*a heat loss of only 6 degrees!*

In addition to its excellent insulating properties, GILSULATE is chemically neutral in all soils, dielectric and waterproof. Why not investigate the value of this low-cost, poured-in-place insulation? For complete information, see your local GILSULATE distributor, or write our Salt Lake City office.

FACTS ABOUT GILSULATE

1. **EASY TO USE**—just pour and tamp...pipe heat does the rest.
2. **FORMS 3 ZONES** of protection against heat loss and all hazards commonly encountered by buried hot pipes.
3. **NEEDS NO HOUSING OR MECHANICAL SHEATHS:** no mixing, special handling or equipment.
4. **ONLY NEEDS NORMAL PIPE SPACING:** for multiple pipe or cramped conditions.
5. **THREE TYPES AVAILABLE:**
   Type A for 220-300° F. temp. range
   Type B for 300-385° F. temp. range
   Type C for 385-520° F. temp. range

THE TRIPLE-ZONE INSULATION FOR LIFETIME PROTECTION OF UNDERGROUND HOT PIPES

GILSULATE®

AMERICAN GILSONITE COMPANY

Affiliate of Barber Oil Corp. & Standard Oil Co. of California

Offices at: Municipal Airport, P.O.B. 15, Salt Lake City, Utah
3537 Lee Road, Cleveland 20, Ohio

Distributors in Principal Countries of the World

Do you receive Pipe Insulation News? Ask to be put on our mailing list.

For more data circle 548 on Post Card

Fig. 1. Trailer-tank made from an old oil circuit breaker tank carries 525 gal of insulating oil to equipment in field. Only thing new is the forward wheel. Total cost of rig was approximately $300

Home-Made Rig for Handling Insulating Oil

By WILLIAM BUCKSHEE

ON MANY electrical systems the handling and transportation of insulating oil is a frequent task. Transformers and oil circuit breakers have to have the oil lowered to make routine inspections, and upon test, should the oil prove to be contaminated, it must be renewed with good oil. In the past, 45-gal drums were used to handle oil, but this is a somewhat laborious and messy method of transporting oil.

These photographs show a trailer-tank that was made up from old parts, and which has greatly facilitated the transporting of oil in moderate quantities, especially on a system that has a number of small substations.

Fig. 2. Cradle in which tank rests on old truck chassis was formed by welding to the chassis

Fig. 3. When welding on empty tank, make sure tank is clean inside, to safeguard against accidents

fold along this line—outside edges toward you

The tank shown is made from an old oil circuit breaker, and the chassis is an old truck chassis picked up in a "graveyard." Openings in the tank, which formerly took the operating mechanism, were closed off by welding in steel plates. The manhole was not altered but left as was, to allow cleaning.

The old truck chassis was first welded to a frame made from heavy channel iron which had been formed to suit the curvature of the tank. The "tongue" for trailing the tank was made from 6-in. channel iron, the eye at the end taking a standard trailer towing device.

Note the forward swivel wheel which by means of a jacking screw allows the tank to be leveled or tilted slightly in order to drain completely. When empty, the trailer-tank can be moved easily by two men. Tank is filled and emptied with a small portable pump.

How to Square Root to Four-Digit Accuracy

By C. M. GILLESPIE *

HERE IS a method for extracting the square root with the help of a slide rule. It can be shown best by four examples. However, it should be noted that it is not necessary to write out the steps except during the learning process. By the time the method has been mastered, further short cuts will appear.

Regardless of the location of the decimal place in the number under the radical, the problem of extracting the square root involves two types of numbers — those with an odd number of digits and those with an even number of digits. If for simplicity we reduce the number in question to one with just a single period to the left of the decimal point, we will then be working with numbers that either have one or two digits to the left of the decimal point. Our examples are of this type.

Example No. 1. Find $\sqrt{2.789}$

1. Inspection tells us the nearest perfect square is 1, the first digit in the answer is 1, and the first trial divisor is $1 \times 2 = 2$. The remainder is $2.789 - 1.000 = 1.789$. The remaining steps are done with aid of slide rule.
2. Divide 1.789 by first trial divisor, 2 = .895
3. Divide 1.789 by first trial divisor, $2 + .895 =$ 1.789 divided by 2.895 = .618
4. Divide 1.789 by first trial divisor, $2 + .618 =$ 1.789 divided by 2.618 = .684
5. Divide 1.789 by 2.684 = .666
6. Divide 1.789 by 2.666 = .671
7. Divide 1.789 by 2.671 = .670
8. Divide 1.789 by 2.670 = .670
9. The total answer will be the first digit in the answer, 1, as found by inspection $+ .670 =$ 1.670.

Example No. 2. Find $\sqrt{34.59}$

1. Inspection tells us the nearest perfect square is $5^2 = 25$, the first digit in the answer is 5, and the first trial divisor is $5 \times 2 = 10$. The remainder is $34.59 - 25.00 = 9.59$.
2. Divide 9.59 by 10 = .959
3. Divide 9.59 by 10.959 = .875
4. Divide 9.59 by 10.875 = .881
5. Divide 9.59 by 10.881 = .881
6. The total answer is $5. + .881 = 5.881$.

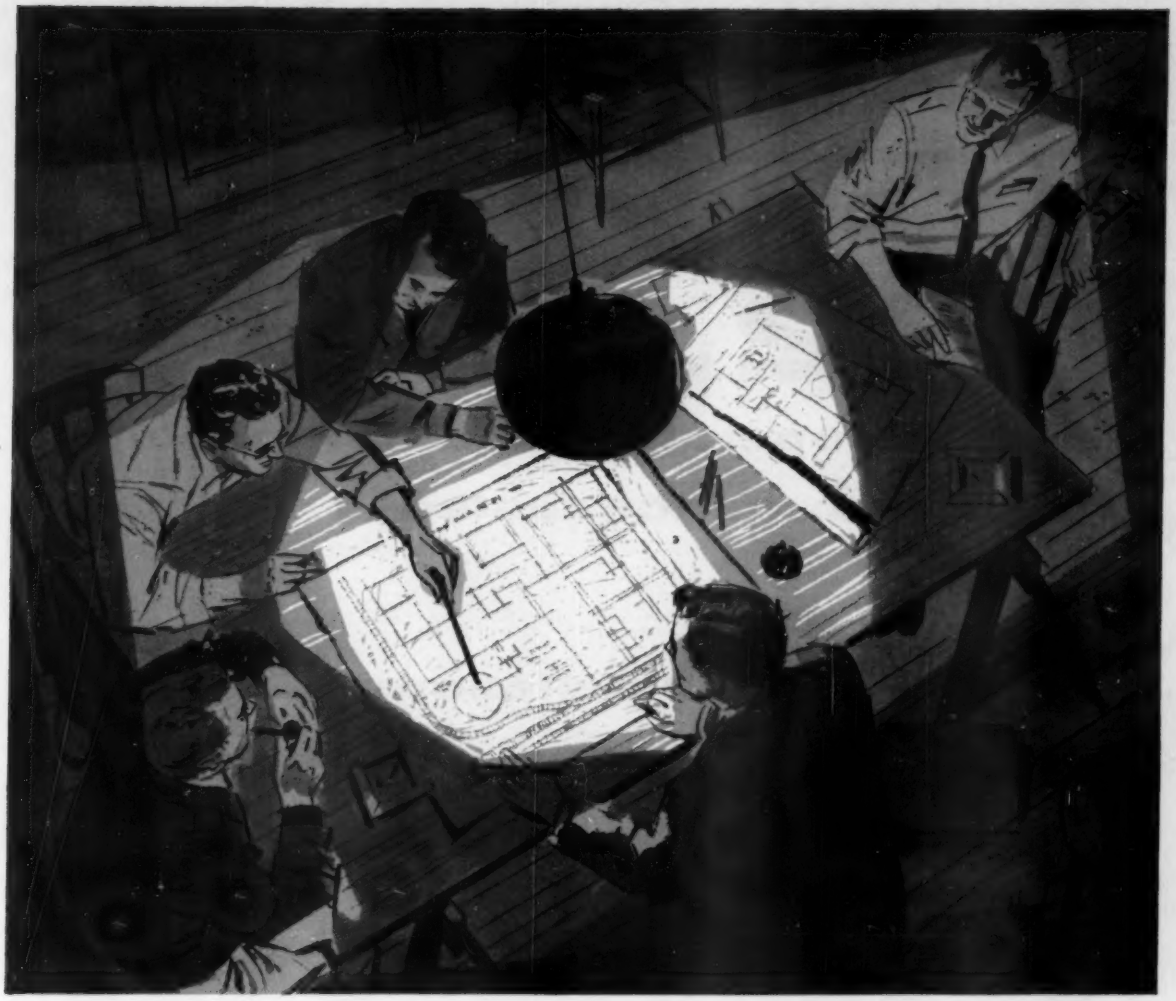
Example No. 3. Find $\sqrt{1.1556}$

1. Inspection tells us the nearest perfect square is 1. The first digit in the answer is also 1, the first trial divisor is $1 \times 2 = 2$. The remainder is $1.1556 - 1.0000 = .1556$.
2. Divide .1556 by 2 = .0776
3. Divide .1556 by 2.0776 (round off, of course; thus .1556 by 2.08) = .0748
4. Divide .1556 by 2.0748 (round off, of course; thus .1556 by 2.075) = .075
5. Divide .1556 by 2.075 = .075
6. The total answer will be 1.075.

Example No. 4. Find $\sqrt{.8764}$

1. Inspection tells us the nearest perfect square is $2^2 = 4$, the first digit in the answer is 2, the first trial divisor is $2 \times 2 = 4$. The remainder is $8.764 - 4.0000 = 4.764$.
2. Divide 4.764 by 4. = 1.19
3. Divide 4.764 by $(4. + 1.19) = 4.764$ by 5.19 = .918
4. Divide 4.764 by $(4. + .918) = 4.764$ by 4.918 = .966
5. Divide 4.764 by 4.966 = .958
6. Divide 4.764 by 4.958 = .960
7. Divide 4.764 by 4.960 = .960
8. The total answer is 2.960

* Assistant Engineer, Generator Design Section, Steam Turbine Dept, Allis-Chalmers Mfg Co



We can give you valuable help

In designing, installing or converting water softening equipment

There's no charge for the services of one of Morton's Consulting Engineers at any stage of your work with water softening systems. Many architects and engineers have already found that calling in a Morton man can save time and work and will result in water softening installations that provide maximum efficiency and the greatest economy of operation.

The Morton Consulting Engineers have experience with all types of water softening systems for all types of uses. The assistance they offer is well worth an inquiry. If you think a Morton Consulting Engineer could be of assistance to you, just send in the coupon today.

I would like to know how a Morton Consulting Engineer could help me_____

I understand there is no charge for this service.

Name_____

Title_____

Company_____

Address_____

City_____ Zone____ State_____

MORTON SALT COMPANY

INDUSTRIAL DIVISION

Dept. PE 259, 110 No. Wacker Drive, Chicago 6, Illinois

For more data circle 549 on Post Card

The Research-Cottrell score on electrical precipitators for 1958:

32 installations put into operation and completely performance-tested

32 installations meet or exceed guarantees

Unprecedented is this record number of 32 installations in one year—all of which met or exceeded their performance guarantees. The chart on the opposite page shows a number of these installations.

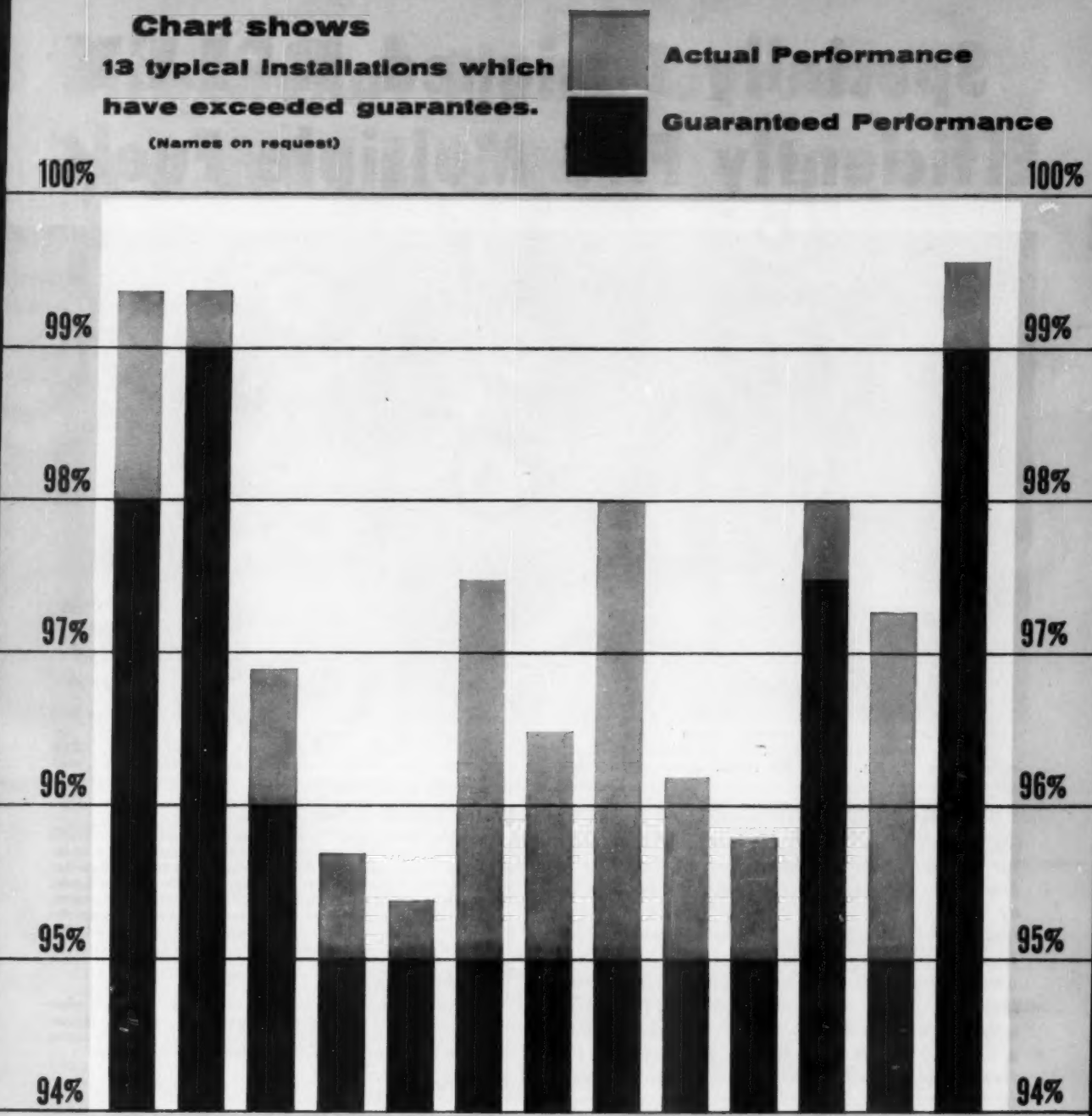
Such a record is no accident. It is largely the result of 1198 years of combined engineering skill and experience—factors which have made Research-Cottrell the undisputed leader in electrical precipitation.

On your next job—if you want the assurance of trouble-free installation and operation, be sure to call on Research-Cottrell.

RESEARCH-COTTRELL, INC. Main Office and Plant: Bound Brook, N. J. • 405 Lexington Ave., New York 17, N. Y.
Grant Building, Pittsburgh 19, Pa. • 228 N. La Salle St., Chicago 1, Ill. • 58 Sutter Street, San Francisco 4, Cal.
Research-Cottrell (Canada) Ltd., 33 Bloor Street East, Toronto 5, Ontario

RESEARCH

Chart shows
13 typical installations which have exceeded guarantees.
(Names on request)



Performance over and above your guarantee is a big extra. For example, in the chart above, the first bar shows an actual loss of only ¼ of the guaranteed maximum loss. This means a far cleaner gas at no extra cost to you.

RC 188

-COTTRELL

Specially Designed RILEY Efficiently Fire Multiple Fuels

Inside the Turbo Furnace at Sterlington Steam Electric Station of Louisiana Power and Light Co. Overall width 54'—7⅞", depth 24'—0-⅜". No. 1 firebrick rubble covers the furnace floor. Twenty Riley Directional Flame Burners are arranged for opposed firing on front and rear walls. Burners are shop fabricated assemblies. Burner close-up shows directional vanes, two

The Riley TURBO FURNACE unit is one of the major furnace design advances in recent years for the more efficient utilization of fuels. It is known as a multifuel unit primarily because of its ability to produce similar furnace exit gas temperatures with gas, oil, coal or other solid fuels. This phenomenum is due to the fact that natural gas, which ordinarily burns with a non-luminous flame, burns in a TURBO FURNACE with a luminous flame similar to oil and coal. In a TURBO FURNACE, fuels are burned with extremely high turbulence at the furnace bottom; in the case of pulverized coal, over a slag pool. Much of the unusual combustion efficiency is due to opposed firing with Riley Directional Flame Burners specially designed for firing multiple fuels singly or in combination. These fuels may be pulverized coal, oil, gas, or other special solid fuels such as fluid coke or lignite.

Water Cooled Burner

The Riley Directional Flame Burner is designed for opposed firing on one level. Each Riley Directional Flame Burner is installed as a unit complete with water cooling tubes which are welded to the waterwall circulation system. The waterwall tube arrangement provides maximum cooling of directional vanes, nozzles and other burner parts and reduces to a minimum the possibility of slag adhesion when coal is being burned. No burner refractories are required.

Coal Burning

Two or three burner nozzles per burner are provided when coal or other solid fuels are to be burned. In this way the coal streams are more evenly distributed across the furnace to assure good mixing of fuel and air in the furnace.

Oil Firing

A retractable type oil gun is inserted thru the center slot so as to provide complete mixing of the spray with the air stream. Oil can be burned with either steam or mechanical atomizing equipment.

Gas Firing

Gas is fired thru guns of high alloy stainless steel. High capacity burners have a gun in each side slot. Gas guns can be installed for mechanical retraction.

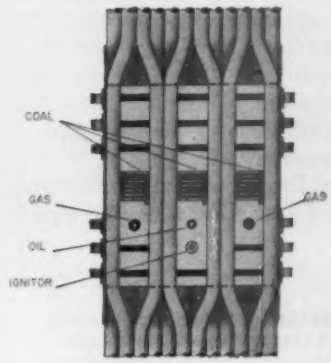
A RILEY TURBO FURNACE GIVES YOU THESE MONEY-SAVING ADVANTAGES

- **The ability to fire multiple fuels: gas, oil and a wide range of solid fuels**
- **A low cost and quick conversion to solid fuels with initial gas/oil firing**
- **Higher heat release with lower overall structure**
- **When firing coal**
  low carbon loss
  clean furnace, no slagging
  elimination of flyash removal with reinjection
- **One level burner operation**

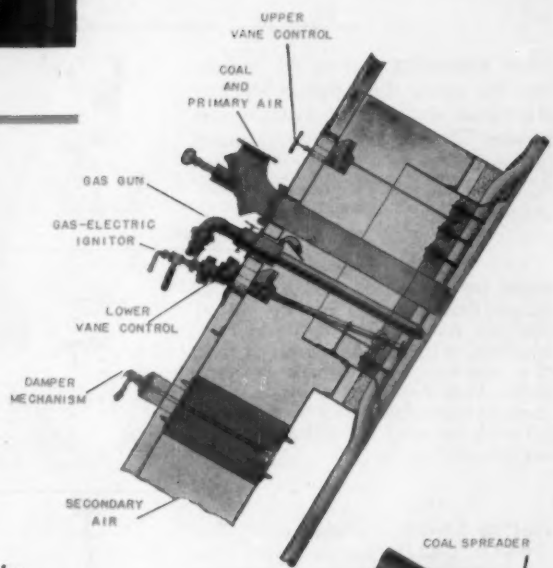
TWENTY THREE RILEY TURBO FURNACE UNITS HAVE BEEN SOLD SINCE ITS INTRODUCTION IN LATE 1954!

Directional Flame Burners in a RILEY TURBO FURNACE

gas guns, gas electric ignitor, observation port. Burner can easily be converted to oil and coal firing.



RILEY
DIRECTIONAL FLAME BURNER
Pulverized Coal, Oil and Gas



Directional Vanes

Each slot is provided with directional vanes to project secondary air into the furnace so as to secure the desired placement of flame for most effective combustion. The vanes above the burner centerline and those below each have separate controls. Vanes are made of high heat resisting alloy.

Burner Shut-Off

Each burner has a separate secondary air shut-off damper which can be locally or remotely controlled.

Riley Gas-Electric Ignitors

Riley Gas-Electric Ignitors are available with Riley Directional Flame Burners.

Pressurized and Non-Pressurized Operation

Riley Directional Flame Burners are designed so that they can be used either with pressurized or non-pressurized furnaces.

The complete story about the unusual operating characteristics of the Riley TURBO FURNACE and DIRECTIONAL FLAME BURNERS can be obtained by writing RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS or contacting a Riley representative in any one of these cities:

Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, St. Paul, Syracuse, Worcester.

RILEY
STEAM GENERATING & FUEL BURNING EQUIPMENT

For more data circle 551 on Post Card

BUTTERFLY VALVE FACT FILE

Where to use Butterfly Valves

The field of use for rubber seat butterfly valves is broad, comprising the handling of large volumes of liquid or gas at pressures up to 125 psi. and at temperatures from —20°F to 190°F. Within this area, inherent simplicity of form and function in the butterfly valve give it great advantages over other types of valves.

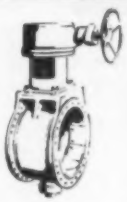
Henry Pratt butterfly valves are light in weight, compact and mechanically simple, factors that greatly reduce the kind of installation and maintenance costs that can be shockingly expensive in valves weighing a ton or more.

As you can see below, the great advantages inherent in butterfly valves have been multiplied, through Henry Pratt engineering, into a wide variety of practical, economical valving for standard operations as well as unusual problems in power and water works systems.

LOW PRESSURE valves are widely used in water works, power stations and industry where pressures range from vacuum to 50 psi. Pratt has built valves as large as 14 feet in diameter for wind tunnel use, and, for air circulation in nuclear power plants, valves that slam shut in 3/10 of a second.

COMBINATION VALVE AND EXPANSION JOINT combines two functions in one unit. This is economical both in material and installation costs because it eliminates one set of flanges and bolts. Units are built with rubber or steel bellows expansion joints.

HIGH PRESSURE valves are excellent for pump discharge-check applications and water distribution service. These valves have an upper pressure limit of 125 psi and velocity capability as high as 55 feet per second.

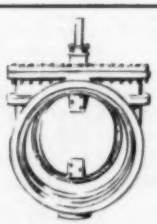


SPECIAL END VALVING. In some installations, such as water main service, flanged connections are not necessary, so both High and Low Pressure Pratt Valves are built with end modifications for bell-and-spigot piping and couplings such as Dresser or Victaulic.

ENDS OF PIPELINES or conduits. Single flange valves can be bolted directly to the end of a pipeline, conduit, settling basin wall or face of a reservoir. Functioning as sluice gates, they have the added advantages of permanent drop-tight shut-off with no need for adjustment or maintenance.

EXTRA LENGTH VALVING. Butterfly valves are often used for economical replacement of other valve types. As Pratt valves are relatively narrow, the laying length is increased by using a wider valve body or adding a spool piece.

LIMITED SPACE. Developed by the Henry Pratt Company, the Ob-Round valve makes it possible to obtain a desired valve area where space limitations prevent the use of a round valve. Ideal for basin or conduit applications.



INSERT VALVING. An original Pratt development that simplifies the replacement of gate valves by butterfly valves. The entire butterfly valve fits inside the gate valve body, saving the cost of removing valve body from the line.

If you would like to know all about Henry Pratt valves, write for our Manual of Rubber Seat Butterfly Valves B-2.

HENRY PRATT

RUBBER SEAT Butterfly Valves

HENRY PRATT COMPANY, 2222 S. HALSTED ST., CHICAGO 8, ILL. • REPRESENTATIVES IN PRINCIPAL CITIES

For more data circle 552 on Post Card

The Valley Camp Coal Company provides a complete combustion engineering service for its customers, actual and prospective.

Meeting with a Valley Camp Representative has been the first step to lowered steam costs for many companies . . . . . *How about yours?*

THE VALLEY CAMP COAL COMPANY

Western Reserve Building • Cleveland 13, Ohio

SUBSIDIARIES —

Great Lakes Coal & Dock Co., Milwaukee, Wis. • Great Lakes Coal & Dock Co., St. Paul, Minn. • Fort William Coal Dock Co., Ltd., Fort William, Ont. • The Valley Camp Coal Co. of Canada Ltd., Toronto, Ont. • Kelley's Creek & Northwestern Railroad Co. • Kelley's Creek Barge Line Inc. • Pennsylvania & West Virginia Supply Corp.

SALES OFFICES —

Philadelphia • Baltimore • Buffalo • Pittsburgh • Wheeling • Cleveland • St. Paul • Cincinnati • New York • Milwaukee • Superior, Wis. • Fort William, Ont. • Toronto, Ont.

For more data circle 590 on Post Card

EQUIPMENT NEWS

Reader Service Cards on pages 123–124 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

1—DIGITIZER converts analog signals to digital code

For punched tape or telemetering applications, the A9M Indicating Digitizer translates the analog signal from company's Autronic transmitters or converters into a digital code. It operates on an 0-0.500 v a-c signal and can be operated in parallel with controllers or recorders. The signal to the digitizer is

amplified and fed to a servo motor driving an analog-to-digital converter. Feedback of the servo's shaft position to the amplifier is accomplished by a differential transformer, rather than by slidewire. The digitizer is housed in a case which fits into a 5-in. square panel cutout. The face of the instrument contains a large dial directly connected to the encoder; it gives continuous indication of the variable. The Swartwart Co.

2—PLASTIC TIES bind wiring harnesses neater, faster

Of nylon base Moldarta material, this cost saving flexible tie offers several advantages over the string method. According to manufacturer, the ratchet-like design makes the plastic tie self-adjusting to a wide range of bundle diameters; it reduces by about 30 per cent the time required to tie a bundle; and the material is fungus and moisture resistant. The tooth form allows bending to a low limit of 1/32-in. radius, while the notched leader facilitates gripping the tie for tightening. Tapered surfaces at the rear of the ratchet buckle and 3/8-in. long tapered surface permits ease in threading the leader through the buckle. Also, the flat-surfaced leader

serves to prevent cutting into the insulation of a group of wires. While this tie may be installed without special tools, a plier has been developed to aid in rapid tying and offers a definite advantage in applications involving many wire ties. Westinghouse Electric Corp.

3—DUCTILE IRON STRAINERS for 600 psi steam pressure

Available for standard pipe sizes from 3/8 to 2 in., these Ductile iron strainers are designed to withstand pressures of 600 psi at 650 F, providing 80 per cent of cast steel service at roughly half the price. According to manufacturer, they offer a safety advantage as the Ductile iron will bend or twist but not break, in case of fire or explosion. This makes them adaptable in applications where the strength of cast steel has been previously required, it is pointed out. Strong, Carlisle & Hammond.

4—CLEANING AGENT removes grease, oil from boiler

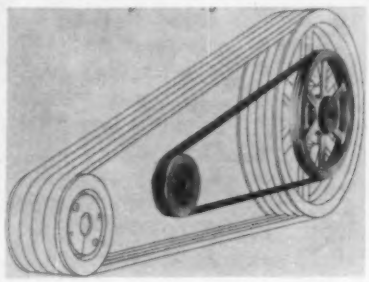
Boil-Out is prepared from organic and inorganic emulsifying and dispersive agents designed to remove oil and grease from new boilers prior to placing on the line. In addition, it can be employed to remove oil from boilers contaminated due to operating conditions. It is not recommended for the removal of boiler scale or mill scale. Boil-Out is furnished in 1-lb briquettes. Betz Laboratories, Inc.

5—PILLOW BLOCKS offer versatility of application

Accommodating all series of spherical roller bearings, this line of pillow blocks is said to offer increased versatility for heavy industrial use. Through interchangeable end caps, 20 basic housings accommodate 94 separate bearings — some housings taking 8 different bearing sizes and 11 shaft diameters. To install a different bearing size, you simply fit new end caps on the housing. For further versatility, housings are center-grooved for universal center lubrication, and end caps have a second connection for side lubrication. Either labyrinth closures or oil seals are available on most caps. To simplify parts replacement, housing bears "easy order plate" stamped with assembly number, sizes of bearing, adapter and shaft, and type of closure. Miether Machine Works.

6—MULTIPLE V-BELT DRIVES offer cost, size reductions

Super HC Belt Drives are announced as incorporating a "four dimensional" design advance resulting in: reduction in width of belts and sheaves; reduction in sheave diameters; reduction in center distances, and — of most importance — reduction in overall costs of the drive. According to manufacturer, the Super HC V-Belt makes it possible to reduce the cost of a drive as much as 20 per cent — and this does not include savings



realized on the use of smaller housings, bases and other components. The new V-belt covers the entire range of drive requirements with only three cross-sections, instead of five formerly necessary. And high-performance materials provide such additional horsepower capacity that cross-section dimensions can be made nearly 50 per cent smaller.

The arched top of the V-belt serves to prevent distortion of the tensile section, permitting each of the tensile cords to carry its part of the load; improved concave sidewalls prevent concentrated wear on the sides of the belt. It is pointed out that with narrower, deeper cross-sectioned high capacity belts and narrower sheaves, this drive design packs up to three times the horsepower capacity in same space. The Gates Rubber Co.

7—PRESSURE REDUCING VALVE features increased flow

No. 11A is announced as an economical pressure reducing valve featuring increased flow, designed to serve steam, air, water, oil and gas applications. Two features claimed for the valve are full ported orifice permitting higher capacities, and economical service. The single-seated No. 11A has a semi-steel body, bronze trim, composition disc and is suitable for initial pressures up to 250 lb. Reduced pressures range from 1-100 lb. Spring ranges are 1-20 lb, 15-50 lb, and 40-100 lb. O. C. Keckley Co.

8—RIGID CONDUIT, FITTINGS produced in aluminum

Aluminum rigid conduit, couplings and 90-deg conduit elbows are announced as approved by Underwriters Laboratories and meeting the same size, shape and tolerance requirements as those for steel conduit. Nominal diameter sizes for the conduit range from 1/2 through 6 in. in standard 10-ft lengths. Larger diameters can be ordered. The conduit is chemically coated inside to make wire pulling easier. Advantages announced for aluminum conduit include light weight (one third that of steel), resistance to corrosion and rust, non-sparking and nonmagnetic. Installation costs are reported less because aluminum is easier to han-

CRANE Pressure-Seal Bonnet Valves

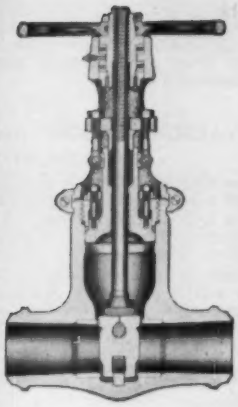
In gate, globe, angle and stop-check patterns—flanged, butt- and socket-welding ends—rated in accordance with A.S.A. in 600-, 900-, 1500- and 2500-pound classes. Sizes: gates—1 to 24 inches; globes and angles—1 to 16 inches; checks—2½ to 12 inches; stop-checks—6 to 12 inches

Crane design is at its very best in this streamlined line of pressure-seal bonnet valves—made expressly for high-pressure/high-temperature service in central stations and industrial power plants.

Bonnet joints in these valves are sealed by a unique method which uses *internal fluid pressure* to effect a leakproof seal. This method virtually eliminates bonnet-joint maintenance—and maintenance costs.

Other features include: weight-saving body design—saving up to 60% over conventional design—swivel action yoke and clamp which permits choice of position for motor or gear mechanism . . . one-piece sealing ring . . . Stellited seating surfaces.

Write to address below for descriptive Circular 1936.



CRANE *high-pressure/temperature valves assure leakproof service–less maintenance*

CRANE Lip-Seal Bonnet Valves

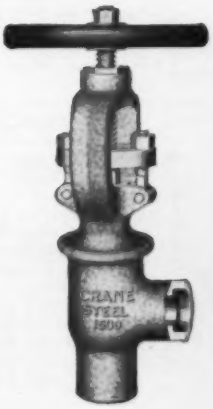
In globe, angle and lift-check patterns; sizes—½ to 2 inches; screwed and socket-welding ends; rated in accordance with A.S.A. in 1500- and 2500-pound pressure classes

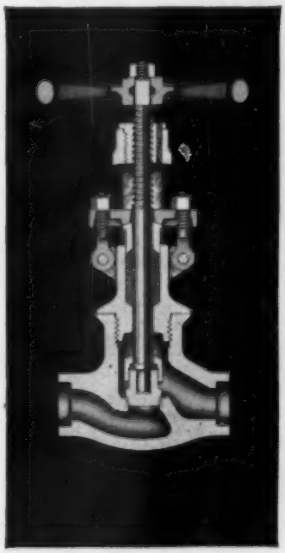
These popular Crane valves are widely used on steam, boiler feed, drips, drains, by-pass, blowdown and similar piping services.

They assure you absolute tightness, no bonnet-joint maintenance, minimum valve weight and bulk without sacrificing strength—and easy, fast dismantling and reassembly.

Features include: lip-seal design which permits re-welding without damage to the valve . . . improved disc-stem connection that minimizes vibration . . . two-piece, non-binding ball-type gland construction . . . and Stellite seating surfaces.

For details, write to Crane Co., for Circular 2099.





For prompt personal service, see your Crane Representative.

CRANE® VALVES & FITTINGS

PIPE • PLUMBING • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill.—Branches and Wholesalers Serving All Areas

For more data circle 554 on Post Card

dle and fewer supports are required for installations of larger sized conduit. Company points out that in diameters up to 1¼ in., advantages of aluminum can be obtained at a slight premium over steel, while the installed cost of aluminum conduit in larger sizes is regularly less than steel. Kaiser Aluminum & Chemical Corp.

9—SPEED REDUCER mounts on the driven shaft

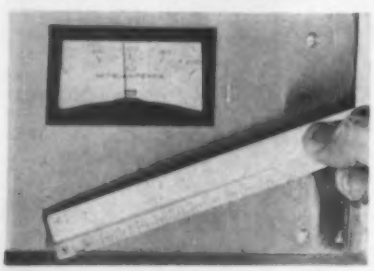
The Shaftex comes in sizes up to 40 hp and with nominal internal gear ratios of 5 to 1, 15 to 1, and 20 to 1. A completely enclosed unit for direct mounting on the driven shaft, Shaftex is available in single and double reduction units. It can be adapted without disassembly, company says, to include back stops where reverse rotation is prohibited and overload releases for chokable conditions. According to manufacturer, the Shaftex is usually driven by a fixed pitch diameter Texrope drive, and variable speeds can be obtained by using either stationary control or motion control Vari-Pitch sheaves. For a higher degree of positive ratio transmission, Shaftex can be operated with a timing belt drive. Bulletin 20B9053 gives details. Allis-Chalmers Mfg. Co.

10—CENTRIFUGAL FANS for wide pressure range

Centrifoil Fans are designed for a wide range of pressures and volumes, with sizes varying from 440 cfm at ¼-in. static pressure for a single-width, single-inlet fan to more than 460,000 cfm at 16-in. static pressure for a double-width, double-inlet fan. The blades on these blowers have an airfoil shape, resulting in greater efficiency, silent operation and reduced horsepower, company says. The Centrifoil Fans are claimed to meet all requirements for commercial and industrial heating and ventilating applications, as well as those of a forced or induced draft nature. Joy Mfg. Co.

11—PANEL METER occupies only a small space

The Model 361 meter occupies panel space of only 3½ by 2 in. and projects only 3/16 in. It exposes only its indicating area, with the remainder of the



meter fitting behind the panel. Dial and window are slanted for easier reading and may be illuminated through a translucent rear window. Sensitivity ranges are given as 0-5 microamperes to 0-50 amp, and 0-5 millivolts to 0-500 volts. The meter slips through a rectangular panel hole and is held in place by rear screw-on clamps. It requires no positioning holes for mounting studs. Assembly Products, Inc.

12—SWITCHBOARD SHELTER protects men and equipment

For outdoor switchboards, this shelter's design consists of a basic unit with an outside door at each end. As additional units are added, end trim is removed, additional units inserted, and end trim replaced on the last unit. Hence, for each integral section of switchboard, only two outside doors are required. According to manufacturer, this arrangement meets safety code require-

ments and minimizes the number of weatherproof outside doors required. Inside, switchboards are located on each side of a center aisle. Switchboard equipment is mounted on inside doors, which swing into the aisle to allow access to the rear of switchboard. Heaters, spun-glass fitters, and fluorescent lighting are provided, also crashproof hardware — even if locked from outside, a push on a release bar unlatches door from inside. Westinghouse Electric Corp.

13—STAINLESS STEEL with high heat, corrosion resistance

To keep pace with higher operating temperatures in power equipment, Armco 22–4–9 Stainless Steel is available as forging billets and rounds from ¾ to 3 in. From the standpoints of economy and strategic element content, the low nickel content (3 to 5 per cent) is said to be an important feature of this alloy. Yet, it is reported to remain austenitic in all conditions. Armco 22–4–9 is claimed to fulfill the need for a strong, hard, erosion- and oxidation- and corrosion-resistant material for service at temperatures of 900 to 1600 F in many applications — as in high-temperature steam valves. At room temperature, this stainless steel is said to exhibit a controlled hardness between Brinell 300 and 550, depending on method of processing. Being austenitic, and due to its composition and heat treatment, this alloy maintains a relatively high degree of hardness and strength at elevated temperatures. It is also non-magnetic. Armco Steel Corp.

14—BELT DRIVEN FANS are quiet, slow speed units

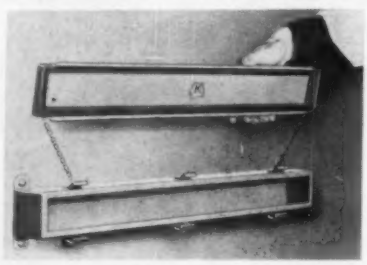
For use where large volumes of air must be moved at relatively low noise levels and moderate pressures, Type CB Fans are designed principally for wall mounting, and standard and heavy-duty shutters are available. They are also suited for use in company's line of Sky-Blast power roof ventilators. They come in 42- to 72-in. sizes with free deliveries from 14,200 to 58,100 cfm. Type CB Fans use airfoil section propellers; their non-overloading characteristics prevent motor overload in event of variable operating conditions, it is noted. Sparkproof aluminum-magnesium alloy used in the cast propellers is said to have great strength and to eliminate bending fatigue. These fans use a heavy-duty bearing assembly and the same assembly is used on all Type CB Fans of any one size, regardless of horsepower, enabling horsepower changes merely by changing motors and modifying the V-belt drives. Totally enclosed motors power fans. Propellair, Div., Robbins & Myers, Inc.

15—GEAR MOTORS, standard units rated up to 200 hp

Announced as the largest standard drive units produced, GearMotor Drives, in sizes J and H, are rated up to 200 hp and claimed to feature efficiencies of 94 to 97 per cent, depending on the number of reductions incorporated. Double, triple and quadruple reductions are available in AGMA ratios ranging up to 440:1. Standard NEMA D flanged motors and standard foot-mounted motors are available, and motors with special mechanical or electrical features can be provided. Philadelphia Gear Corp.

16—ENCLOSED TROUGHS protect electrical wiring

These troughs are suggested for installation of electrical wiring on machinery, in buildings and outdoors — wherever protection against oil, dust and water is required. Design features include removable clamping covers with Neoprene



gaskets. Troughs and covers are assembled by semi-hinges on one side, screw-type clamps on the other. In addition, covers are chained to the troughs. There are no holes or knockouts, seams are welded, and external mounting feet are provided. The troughs are made to JIC specifications, of heavy code gage steel, available in four sizes from 2½-by-2½ in. to 8-by-8 in., lengths from 1 to 6 ft. The standard finish is gray enamel. Keystone Mfg. Co.

17—VERTICAL MOTORS, weather protected for outdoor use

This line of NEMA Type II vertical weather protected motors for heavy duty industrial applications is designed for year-round use where continuous operation under severe weather conditions is necessary. They are the vertical counterpart of company's horizontal weather protected motors. The vertical motor features direct blow-through passages, permitting high velocity air to pass through motor without entering active parts. It also has a series of low velocity air lifts combined with labyrinth turns and baffles to precipitate any moisture or

TIPS ON TUBES

How to prevent tube failures like this

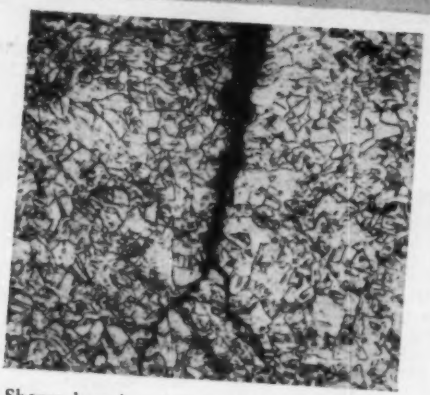


PHOTO shows the complete circumferential crack and pitting on the inner surface. You can also see the shallow pits which have the silvery-colored surface (white spots). Microscopic and visual examination disclosed the tube section to be free from manufacturing defects and metallic or non-metallic inclusions.

PHOTOMICROGRAPH of a section of the tube showing a transgranular crack which progressed from the inner surface.

Shown here is a failed section of ¾" O.D. x 0.065" wall 70-30 cupro-nickel condenser tube. The outer surface of the tube is in good condition, but the inner surface is covered with a thin, brown scale composed mainly of iron oxide, copper oxychloride and copper oxide.

In the region of the circumferential crack the inner surface is pitted, the pits being very narrow and some quite deep with a minimum depth of 0.014". Elsewhere, the inner surface is only slightly pitted but there are several pits whose surface have a silvery color and which penetrate the tube wall to a depth of about 0.005".

The silvery-colored surface suggested that mercury was present. A spectrographic analysis was made at several points and in all cases the presence of mercury was definitely established, with the amount quite variable throughout the scale.

CAUSE OF FAILURE AND SUGGESTED ACTION TO TAKE

Failure of this tube was due to a corrosion-fatigue attack progressing from the inner surface. A pitting attack, caused by the presence of mercury, created focal stress concentration points from which the cracking originated. As the pitting progressed, the localized stress increased in magnitude due to increasing stress concentration at the base of the pits. When the localized stress exceeded the endurance limit the metal was subjected to fatigue cracking.

The stresses which caused the transgranular cracking were cyclic and were produced by severe vibration of the tubes during operation of the condenser.

To eliminate this type of failure it will be necessary to determine what is causing the excessive vibration of the tubes and to eliminate or sufficiently reduce the vibration.

Revere can help you solve similar condenser tube problems through its Technical Advisory Service.

Revere's Technical Advisory Service, because of its long and varied experience, is qualified to help in the selection of the alloy best suited to the specific set of operating conditions encountered in *your* power plant. This experience, which has covered many and varied types of problems, has been instrumental in prolonging tube life for power plants both large and small.

Why not take advantage of this storehouse of knowledge and contact Revere before making the final selection of tubes and plates for your equipment?

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Rome, N. Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities, Distributors Everywhere.

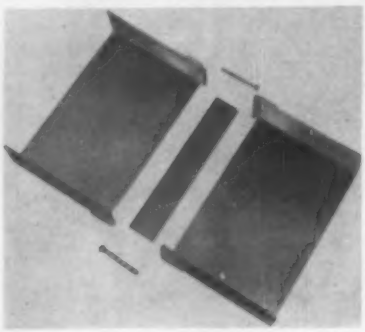
COPPER * BRASS * 18 01 * REVERE * ALUMINUM

For more data circle 553 on Post Card

other contaminants [before] ventilating air reaches electrical parts. Motor comes in all typical vertical configurations, such as solid shaft, hollow shaft, self-release couplings and non-reverse ratchets. General Electric Co.

18—SUPPORT SYSTEM, for control cable, instrument tubing

Controlway is claimed to provide the lowest installed cost of any cable supporting system. It is reported especially suitable for use with control and signal



cables where circuits under 600 v are not in continuous operation and ventilation is unnecessary. Of galvanized steel, Controlway is available with or without covers, and includes a complete line of fittings. Straight sections come in 10-ft lengths, in widths of 9, 12 and 18 in. Sections and fittings are joined with pin-type coupler. T. J. Cope Div., Rome Cable Corp.

19—SOLID FRONT GAGES have safety advantages

These gages cannot blow out toward the front, it is stated, as a shield is cast as an integral part of the rigid case construction. A Nylon back blows out at case pressures less than 2 psi should the tube leak or fail; this back is secured to the gage case by a stainless steel chain. Design features of the gage are said to allow full access for ease of adjustment, a sturdy socket assembly in a selection of construction materials, and wrench grip on pressure connection. The rotary, geared, stainless steel movement is designed so that errors in angularity may be corrected by pivoting movement around axis. Crosby Valve & Gage Co.

20—TRAMP IRON SEPARATORS have improved ceramic magnets

Indox ceramic permanent magnets are featured in this line of tramp iron separators. The ceramic material is announced as barium ferrite, pressed into a compact under great pressure and permanently magnetized to produce an ideal flux pattern for effective tramp iron separation. When installed at head of belt conveyor system, the Indox V magnetic pulley is said to outperform many conventional permanent magnet pulleys and equal the deep-field power of electromagnetic types. Also, the radial design of magnet assembly boosts holding efficiency.

The Indox grate magnet is installed in hopper or floor opening, chute or duct. Collecting tubes have continuous magnetic poles, no "dead spots," it is stated, and the effective area is 400 per cent greater than in many types of grate magnets. The Indox-V magnetic drum, for industries where granular materials are conveyed in enclosed chutes and spouts, is said to produce a uniform field 30 to 40 per cent stronger than most permanent magnet drums. Superior separating efficiency is also claimed for the Indox-V plate magnet. Stearns Magnetic Products.

21—BULK FEEDER UNIT for dry granular materials

Screwfeeds covering a capacity range to 3000 cfh of dry granular material are announced as self-contained units for bolting to the base of a hopper. The unit consists of a totally enclosed motor, reducer, drive, guard, screw and housing with flanged inlet and outlet. Modifications as to size of inlet or outlet, motor style and location are available. The general purpose unit is of carbon steel; a corrosion resistant style uses Type 304 stainless steel for all parts in contact with the material. A sanitary style is built for easy disassembly and cleaning with all parts contacting the material made of Type 304 stainless steel. Where rate of feed is critical or must be varied, a variable speed drive is furnished. The M-H Standard Corp.

22—TUNGSTEN CARBIDE SPRAY for hard facing application

This spray-powder material is claimed to permit hard facing with sprayed tungsten carbide at high deposit efficiency — better than 90 per cent and high concentration of the carbide. Coating speeds are also claimed high — 110 to 150 sq ft per hr, 0.001 in. thick. Any required coating thickness may be applied. Coatings are torch-fused after spraying and the close control of coating thickness permitted, plus the comparatively smooth surface produced, is said to minimize finishing operations. The product is expected to find application on parts subject to extreme wear conditions. Bulletin 139 gives details. Metallizing Engineering Co., Inc.

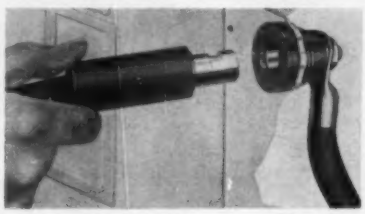
23—BUTTERFLY VALVE features design improvements

In the Leopold AWWA Butterfly Valve, a "Uni-Wedge" method of seat retention allows the seat retaining pressure to be externally adjusted with the valve

in place in the line, it is announced. Only two seat retaining screws are utilized and these are not in contact with the flowing medium, so corrosion is not a problem, company points out. Valve disc and rubber seat arrangement at disk hub are designed to avoid premature seat failure. The valve has a flanged valve body, nylon cloth reinforced, resilient rubber or synthetic seat, and heavy-duty operating parts. Standard models are for line sizes from 6 to 48 in., for maximum line velocity of 8 or 16 fps, and for maximum shut-off pressures of 25, 50 or 125 psi. They're built to conserve space, may be mounted in several positions with manual or automatic operators. F. B. Leopold Co., Inc.

24—PANEL RECEPTACLE of high-impact plastic

Manufacturer announces that because this receptacle is self-contained and self-insulated, it can be mounted, without further insulation, on electrical distribution cubicles, switchgear, junction boxes, bus duct, wireway etc. to produce an economical "dead front" connection. The high-impact plastic insulation is claimed to provide shockproof panel



mounting, prevent short circuiting of power distribution equipment and safeguard personnel.

The receptacle, with its mating plug, affords a rapid means of connecting and disconnecting power cables. The recessed copper-in-plastic design also incorporates a locking connection with a high-pressure contact, to prevent accidental uncoupling. The connection withstands a pulling force of 1000 lb, says manufacturer. No special tools or fasteners are needed for installation. After a hole is punched in the panel, the threaded plastic receptacle is inserted and tightened in place with standard electrical conduit lock nut. The threaded copper stud is the terminal for attaching power leads. Receptacles accommodate cable sizes from No. 16 to 4/0. Cam-Lok Div., Empire Products, Inc.

25—LEVEL CONTROL has explosion-proof design

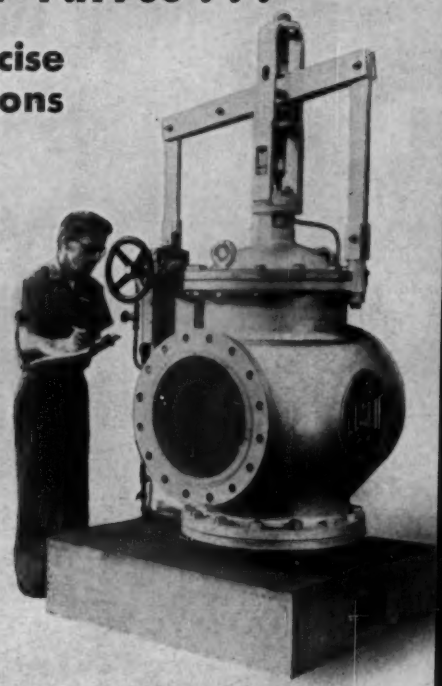
The electronic Level-Trol, Type 2300, uses company's conventional pneumatic Level-Trol cage and displacer float as the measuring element, and delivers a proportional 1 to 5 milliampere d-c signal through a 3000 ohm load. Standard 117-v a-c is employed as the supply. Explosion-proof design and external adjustments for proportional band and liquid level height render the Type 2300 suitable for use in hazardous locations, it is noted. Fisher Governor Co.

26—THERMOCOUPLES withstand rigorous service

Con-P-Pak Thermocouples are designed to meet severe demands required of controls and instruments used in melting furnaces, nuclear reactors and in the processing of liquid hydrogen, fatty acids, alcohols and other difficult materials. A number of metal combinations are used, such as copper-Constantan for temperatures down to −300 F and rho-

LESLIE - *lifetime control valves . . .*

A complete line for precise power applications



Leslie Co. offers a wide range of single seated valves in sizes ½" to 16" and double seated control valves. In addition, there are many new standard valves designed specifically for power industry applications in both sub-critical and super-critical power generating stations. Valves are available with these power service features:

- **Exclusive Leslie seat protections eliminate erosion problems in high-pressure drop throttling services.**
- **New Leslie "cage" construction permits replacement of inner valves, seats and guides without removing valve body from the line. Down-time for replacement or inspection is cut to a minimum less than 20 minutes.**
- **Control valves in extremely severe high-pressure drop service have infinite rangeability.**
- **Stellite faced and solid stellite inner valves and seating surfaces for maximum erosion resistance.**

Leslie control valves are designed to handle hot and flashing condensate . . . temperatures to 1150°F per ASA rating. They are providing reliable service under extremely severe operating conditions in a variety of central station applications such as:

- **Condensate drains from feedwater heaters**
- **Boiler feed pump recirculation**
- **Desuperheater spray water control**
- **Turbine lead drain remote manual start-up control**

You may choose from a variety of sizes and diaphragm actuators to accommodate almost any operating air supply up to 100 psi. In addition, electro-mechanical, pneumatic cylinder and electro-hydraulic actuators can be supplied.

For specific engineering data, write today for data sheets illustrating the cage trim construction and other Leslie features.

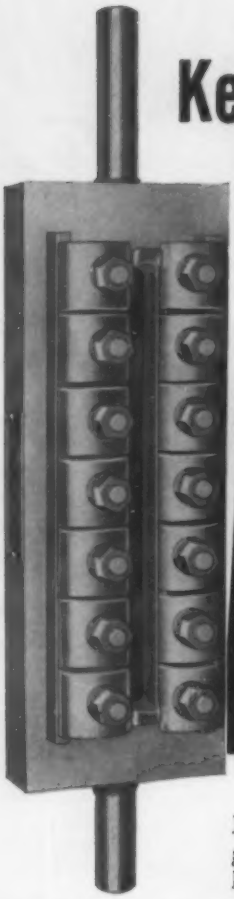
TRADE LESLIE MARK

REGULATORS and CONTROLLERS

LESLIE CO., 301 Grant Avenue, Lyndhurst, New Jersey

Keep the "eyes" of your boilers safe

... to protect life and property

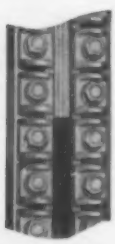


Use
Reliance Water Gage Inserts
for leak-tight shatter-proof service

New Reliance Mica-protected Flat Glass Gage Insert for steam pressures to 1500 psi. Rigid wide body; improved Reliance finger-type clamping principle.

It's false economy to "scrimp" on water gages. These vital basic checks on water levels should be of highest quality, assuring continuous clear reading, and safety for workers and equipment . . . A few hints worth considering:

1. See that you have gage inserts on all boilers and supplementary vessels corresponding with the design pressure.
2. Insist on frequent inspections and maintenance to *prevent* trouble.
3. Keep spare inserts and replacement parts on hand for prompt use when needed. (Many plants use spare inserts when necessary to keep gages in continuous service — make repairs when convenient.)



Reliance PRISMATIC Gage Insert shows sharp black-white contrast between water and steam. Models for pressures to 350 psi.

Reliance, oldest manufacturer *specializing* in boiler safety equipment, makes water gage components for all pressures, any visibility range. Also direct-to-drum assemblies. Extra strength — a generous margin of safety — is built into all Reliance products. When you write, please mention your working pressure.

The Reliance Gauge Column Co.
5902 Carnegie Avenue • Cleveland 3, Ohio

Reliance BOILER SAFETY DEVICES

1884 75th YEAR 1959

For more data circle 557 on Post Card

dium platinum for temperatures over 1600 F. Thermocouples have conductors encased in ceramics and surrounded by metal sheaths. Various junctions and tips are available as well as several connectors. Electrical properties are claimed excellent—insulation resistance between wires and sheath ranges up to 100 megohms at 500 v.d-c and dielectric strengths to 2000 v a-c. Continental Sensing, Inc.

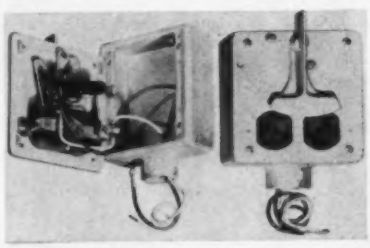
27—ISOLATED PHASE BUS with round enclosures

This isolated phase bus has round enclosures and single insulators at each conductor support station; it is claimed to withstand higher internal pressure then bus with conventional square enclosures. Constructed of a cylinder rolled from a sheet of aluminum, this bus eliminates need for a pressure relief, such as breathers, it is noted, because of the round enclosure and absence of porous gaskets. Sealer-type and closed cell Neoprene sponge rubber gaskets are used to keep out moisture.

Available in ratings of 14.4 kv, 23 kv and 34.5 kv, with current ratings of 1200 through 20,000 amp, this bus incorporates a T-bar which serves to prevent displacement of enclosures during short-circuits and helps prevent cross-sectional distortion due to magnetic forces between adjacent enclosures. Quick-opening covers make it unnecessary to disturb major gaskets during inspection. According to manufacturer, this bus meets requirements for both normal and momentary current ratings. General Electric Co.

28—RECEPTACLES for use in hazardous places

Used like ordinary wall plugs, these non-sparking economical wall-mounted interlock receptacles are designed to permit using any cord set safely in hazard-



ous locations as defined in National Electrical Code. Company says the plug can be inserted and locked into the receptacle with no danger of sparking, and a safety cam lever locks the plug in place. The locking cam operates a tilting mercury bottle switch which prevents insertion or removal of plug while current is on. Panellit, Inc.

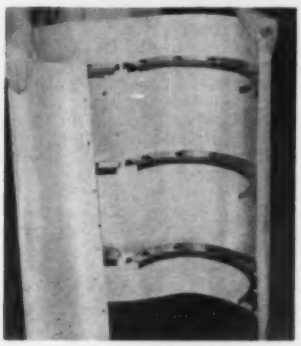
29—PIPELINE AFTERCOOLER for air compressor service

Designated Type A-100, this line of pipeline aftercoolers is designed to cover conditions encountered in industrial air compressor service. The standardized series features improved separator which employs centrifugal force to remove entrainment from the line. The "counter current flow" design (air in tubes flowing counter to water in shell) permits coldest

(incoming) water to serve coldest (outgoing) air for maximum heat transfer efficiency. All sizes are rated for 10- or 15-deg temperature approach. Aftercoolers come in 54 models with capacities for operating pressures up to 125 psig for single and two-stage compression. Bulletin 302.6K1 gives details. American-Standard, Ross Heat Exchanger Div.

30—RINGS attach aluminum jacketing to hot stacks

Premetco Stack Rings are introduced to simplify attachment of aluminum jacketing around high stacks or other hot non-insulated piping. Air escape holes spaced around the steel rings serve to let



heat flow upward out of the stack, while the jacketing, held away from the hot surface, remains cool. Made in 90-deg circle segments, the rings can be spot welded around the stack during or after construction. Rings are formed from 0.032 mild steel with a zinc chromate coating, and can be had in any desired diameter. For even faster installation these stack rings can be ordered with factory attached 0.020-gage aluminum jacketing. These rings can also be furnished attached to aluminum ells to cover bends in hot lines. Preformed Metal Products Co., Inc.

31—VALVE POSITIONER designed for maximum sensitivity

Model J, a top mounted integral positioner, is claimed capable of matching or exceeding speed and sensitivity of modern pneumatic controllers. It is described as combining force-balance design with pilot-operated relay valve, providing high power output and maximum sensitivity. Model J is suitable for use on both cylinder and diaphragm type actuators. It is capable of an infinite number of stroke lengths up to 8 in., in any combination of control forms through a variety of models, company says. Linearity is claimed better than 1 per cent, regardless of stroke length. Increasing or decreasing outputs may be applied to either top or bottom of an actuator in a single mounting of positioner. Zero adjustment is readily accessible and can be made while in operation. Completely enclosed, unit has aluminum housing. Conoflow Corp.

32—SUBSTATION TRANSFORMERS with low maintenance features

Available in ASA standard ratings, 750 to 10,000 kva, three phase 69 kv and below, this standardized core-form substation power transformer is said to offer lower maintenance as well as stream-

MAINTENANCE CUT 90%

ACE Rubber-Lined Ash Pipe

. . . saves 20 days a year turning and patching pipe at New Haven Railroad's Cos Cob Power Plant

Cinders and fly-ash pouring down this 300-ft. long pipe from the ash handling system of the New Haven Railroad's main power plant quickly scoured holes in cast iron pipe. To save trouble, the heavy pipe was rotated ⅛th of a turn every three months, a few sections at a time. The job took five days.

Then Ace rubber-lined pipe was installed. Its remarkable abrasion resistance kept it in service for three years before turning! Even then, its light weight made it possible to turn 200 ft. at once, finishing the job in one day instead of five.

Ace pipe, lined with rubber developed especially for ash systems, offers *you* these savings too. It's one of *nine* types of Ace plastic and rubber pipe made for tough jobs.

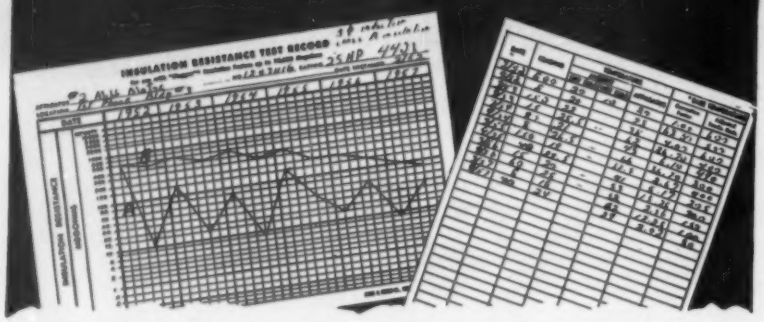
AT LAST! A PERMANENT CURE FOR CONDENSATE RETURN LINE CORROSION

Extensive tests show Ace Tempron pipe... rigid, heat-resistant nitrile hard rubber ...is immune to hot, corrosive steam condensate. Ask about it.

AMERICAN HARD RUBBER COMPANY
Division of Amerace Corporation
ACE ROAD · BUTLER, NEW JERSEY

For more data circle 558 on Post Card

"A STITCH IN TIME" SAVES DOWNTIME



In other words, a "test in time" often avoids a costly machine outage, production loss and serious maintenance expense. The Test Record shown here is an example of how periodic measuring with a Megger® Insulation Resistance Tester gives you advance warning of impending trouble on an electric motor. This motor was repaired on a planned outage rather than under emergency conditions. Other dependable Biddle testing instruments are equally useful to detect trouble before it develops.

MEG® TYPE OF MEGGER INSULATION RESISTANCE TESTER— Available hand-operated, rectifier operated, or with a separate rectifier. Ranges up to 2000 megohms and 1000 volts d-c in all three models. BULLETIN 21-45- and 21-46-PE

MEGGER GROUND TESTER measures the resistance of earth to ground connections simply, easily and accurately, and thereby helps to determine whether such connections will perform the services for which they were designed & installed. BULLETIN 25-PE

SPEED MEASURING INSTRUMENTS — Frahm®, Jagabi®, Dr. Horn, Metron, Jones Tachometers, Jagabi Speed Indicator and Jagabi Tachoscope. There's a Biddle tachometer to suit every maintenance need— to check speeds accurately for load, friction, power transmission and lubrication. BULLETIN 35-PE

MEGGER LOW RESISTANCE OHMMETER — Battery or rectifier operated. Four ranges 0-1000 microhms down to 0 to 1 ohm. New clamp type test leads 18 ft. long enable one man to make tests. BULLETIN 24-46-PE

...serving your industry since 1895

B-605

JAMES G. BIDDLE CO.

Electrical Testing Instruments • Speed Measuring Instruments
Laboratory & Scientific Equipment
1316 ARCH STREET, PHILADELPHIA 7, PA.

For more data circle 539 on Post Card

lined appearance. These are accomplished by use of internal rather than external tank bracing and central location of accessories in a locked weatherproof cabinet at eye level. The rounded corner tank is lowered over the core and coil assembly and welded at the base. This allows core and coils to be bolted to transformer base for rigidity and reduced untanking height and weight. Westinghouse Electric Corp.

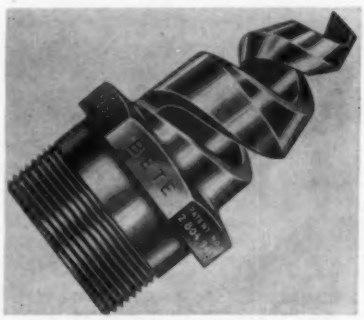
33—SNUBBER resists shock and vibration loads in piping

Vibrasnub, a hydraulic vibration snubber, is an outgrowth of company's ball-type flexible struts with a self-contained hydraulic cylinder integral in the strut. The Vibrasnub functions as a stop or restraint for dynamic vibration and shock loads. It is explained that such rapid movements may or may not be accompanied by a slower, natural movement, such as thermal expansion or contraction. Rapid vibration movements are restricted by the snubber assembly, while more gradual thermal movement is accommodated by by-passing hydraulic fluid through a restricted orifice in the piston of the snubber cylinder. The ball-type strut joints on each end of the assembly permit-10-deg alignment movement.

With the Vibrasnub, shock or vibration loads are restricted instantaneously, manufacturer states; the Vibrasnub is not a damper which merely decelerates movement. Low cost, simplicity and long life, with little maintenance are reported for the snubber. Two sizes are available: a 2½-in. size with 7000-lb load capacity, and 4-in. size with 20,000 lb capacity. Catalog 229A gives details Barco Mfg. Co.

34—SPIRAL NOZZLE for transformer fire protection

Designed for protection of transformers from fire, the N-9 Spiral Fog Nozzle is claimed non-clogging. Only four of these



nozzles per transformer are required for full protection, according to manufacturer. The N-9 delivers approximately 100 gpm at 25 psi with a hard driving 75-deg full cone spray. Of cast bronze, it has 1½-in. male pipe thread. Approval by Factory Mutual Laboratories is announced for the N-9 Nozzle. Bete Fog Nozzle, Inc.

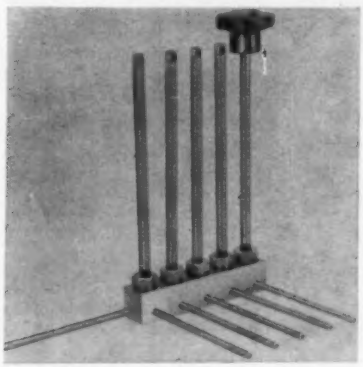
35—SHEAVE features simplified pitch diameter adjustment

The economical Adjustex is a simplified design, stationary control adjustable speed sheave for A, B, and C section belts in two- to four-groove construction.

Pitch diamater sizes parallel company's former Vari-Pitch sheaves. One entirely new diameter for C section belts — 7.5/9.7 in. pitch diam — is available for higher speed and wider speed range applications. Design capacities to 75 hp are covered by 33 sizes. Interdigitated lug disc design is retained. Pitch diameter adjustment is made through a single adjusting screw and a hollow lock screw. Manufacturer says relative position between stationary and movable discs is maintained at all pitch diameters without disc to main sleeve set screws. Allis-Chalmers Mfg. Co.

36—PACKLESS VALVE MANIFOLD with minimum holdup

This compact manifold consists of five packless valves having 0.0006 cu in. volumetric displacement. It can be cam actuated for programming applications.



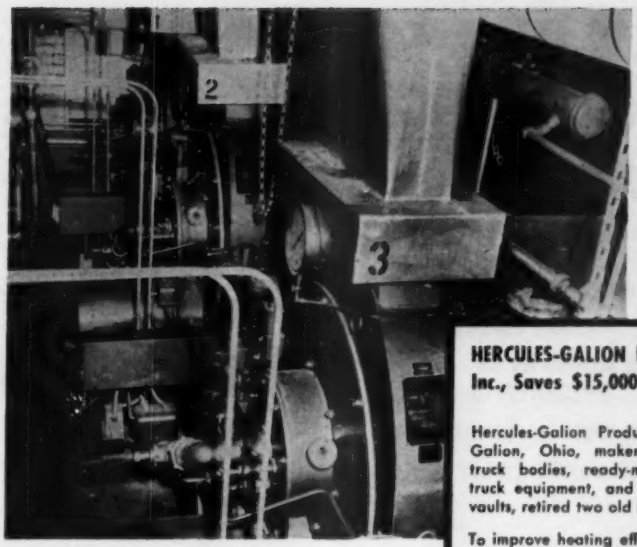
Soldered, welded, tubing or NPT connections with applicable materials for high temperature or low, for high pressure or vacuum service, are available. Minimum holdup reduces contamination of sample, it is noted. The unit shown is all stainless steel with common inlet and individual outlet connections, stainless steel tubing, 1/16 in. ID, 1/8 in. OD. The George W. Dahl Co., Inc.

Described on these pages are new and improved products. Use Reader Service Cards on pages 123–124 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

37—ROTAMETERS measure flow of hard-to-handle fluids

These metal tube rotameters are designed for service with hazardous and high pressure fluids to 400 F. Fluid handled contacts only the metal metering tube, the metal extension tube and the metering float (or rotor) with extension rod. The rotameters are stocked in stainless steel construction for all fluid-contacting components, but can be ordered in other materials. The magnet is Teflon coated.

Fluid enters at the bottom of the tube, flows upward and exits through the side flanged opening. The diameter of this tube increases upward. As the fluid flow increases the float rises — the annular area between the float and inside



HERCULES-GALION PRODUCTS, Inc., Saves $15,000 Per Year!

Hercules-Galion Products, Inc., of Galion, Ohio, makers of dump truck bodies, ready-mix concrete truck equipment, and steel burial vaults, retired two old style boilers.

To improve heating efficiency, they installed three Cyclotherm 125 h.p. combination light oil/gas package steam generators. The total savings per year comes to $15,000.

As growing production or expanding plant facilities require more steam, Cyclotherms can be added when needed.

CYCLOTHERM

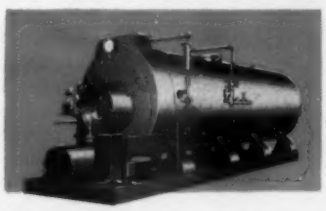
Steam capacity that grows with the plant!

When you recommend Cyclotherm Steam Generators you recommend a steam source that can be quickly and economically expanded to meet plant expansion. For Cyclotherm's wide range of capacities permits the addition of exactly as much new capacity as may be needed at any time. Will 518 lbs. of steam per hr. suit the requirements? That's what a 15 HP Cyclotherm produces. Or are 25,875 more steam lbs. per hour wanted? In that case, a 750 HP Cyclotherm fills the bill. And between these extremes there are sixteen intermediate sizes to choose from.

Compact Cyclotherms are also kind to boiler room space – the Cyclotherm is up to 1/3 smaller than the ordinary package boiler. Installation is easy – no costly stack, no excavation, no foundation. The Cyclotherm is shipped complete – ready to operate. Burner and boiler are built together to work together with *one* manufacturing responsibility back of the entire unit.

Cyclotherm's Cyclonic Combustion guarantees a minimum of 80% efficiency. Larger units operate at from 30% to 100% of rated capacity with no loss of efficiency. Smaller units operate on and off automatically according to load requirements. With simpler design and fewer parts, Cyclotherm reduces maintenance costs by from 30% to 50%. Cyclotherm's world-wide service organization gives prompt service on every call. For full information, write us today.

There are 18 Cyclotherm models, ranging from 15 HP to 750 HP. Burns oil and/or gas. The Cyclotherm meets all state requirements and is built in accordance with A.S.M.E. and National Board Standards and bears the label of Underwriters' Laboratories, Inc. Guaranteed against any defect in materials or workmanship. Cyclotherm also manufactures a complete line of Hot Water Generators in 10 capacities, from 670,000 BTU per hr. to 6,700,000 BTU per hr.



YEARS AHEAD IN STEAM & HOT WATER GENERATION
CYCLOTHERM®
STEAM AND HOT WATER GENERATORS
A Division of National-U.S. Radiator Corp.
50 E. First St., Oswego, N. Y.

Clip to Your Letterhead:

50

Please send me free 4-page folder on Cyclotherm Steam and Hot Water Generators.

For more data circle 560 on Post Card

NOW···GLOBE OFFERS···
two new INTERCHANGEABLE trays for support of cables, wiring and tubing

★ Engineered for uniform design and easy installation
★ Steel or aluminum construction
★ Complete accessories for SPEEDIER Installation
★ No sharp edges to damage cables
★ Complete interchangeability

Now, for the first time, two types of cable trays, one a ladder type and the other a basket type, are available to be used INTERCHANGEABLY at any given location, depending on the type and weight of the cables to be suspended. The advantages of each type tray can thus be used to the fullest extent. Globetray, the ladder type, is intended for use where festooning is not a problem, while Cable-Strut, the basket type, is intended for the support of communication wire, instrument tubing and control cables in automation applications.

These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants, in modernization, and for power distribution in all types of manufacturing processes. A new catalog, just off the press, gives full information and installation techniques. Ask for your FREE copy today.

Distributors are to be found in all principal cities—consult the yellow pages in your phone book under "Gratings" or "Conduits" for the one nearest you.

109

PRODUCTS DIVISION

The **GLOBE** *Company* MANUFACTURERS SINCE 1914

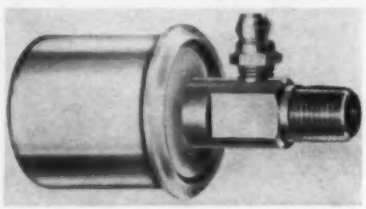
4022 SOUTH PRINCETON AVENUE, CHICAGO 9, ILLINOIS

For more data circle 561 on Post Card

surface of the tube must increase to permit greater flow. Because the fluid exerts a force on the float which is proportional to the rate of flow, the float maintains a fixed position for any rate of flow within the instrument's range. The follower outside the extension tube is magnetically coupled to the magnet fastened to the upper end of the extension rod. Therefore, the position of the flat determines that of the follower along the scale in the indicating head to show the rate of flow. Capacity ranges run from 0.24 to 2.4 gpm to 10 to 100 gpm. Bulletin 19A gives detailed information. Schutte and Koerting Co.

38—BEARING LUBRICATOR injects grease as needed

This low cost bearing lubricator holds a reservoir of lubricant and is designed to automatically inject grease only as required. The position of the pressure cup on the unit shows the amount of



grease remaining in the reservoir. Measuring 2¼ in. long by 1⅛ in. in diam, lubricator is installed one to each bearing by simply removing the Alemite or Zerk fitting and screwing lubricator into place. Manufacturer says the lubricator will operate in any position and can be mounted in cramped positions with standard adapter fittings. The combination of bearing vacuum and spring pressure in the lubricator discharges only enough grease to replace amount used in bearing, company says, and eliminates bearing burnout and over- or under-lubrication. Anchor Chemical Co.

39—HIGH POWER TRANSISTORS for switching, amplifier use

Rated at 2 to 5 amp, these silicon transistors (WX1015 and WX1016) each have a collector-to-emitter range from 30 to 300 v and are designed for switching power up to 1 kw. These units are of n-p-n construction. The high voltage and current ratings of these transistors, together with low saturation resistances (maximum 0.7 and 0.5 phms, respectively for the 2- and 5-amp units), enable either to handle high switching power with minimum losses. The transistors are characterized by small case-to-junction temperatures to 150 C. Each is hermetically sealed in a welded stainless steel case, for mounting on an external heat sink by a threaded stud. Westinghouse Electric Corp.

40—BUCKET ELEVATOR PULLEY for belt tracking

These welded-steel bucket elevator pulleys have roll crowned pulley rims for easy belt tracking. Two types are available; face widths up to and including 13 in. are made with one center disc; and pulleys with wider faces have two discs and two hubs. Center discs are corrugated so that pull stresses resulting at

the hub section are dissipated. Hubs, saw-slit through one side, have tapered shoulders which match the inside tapered bore of the discs. High-tensile bolts pull each hub into its mating disc and clamp pulley to its shaft. The American Pulley Co.

41—REDUCING VALVE for gas, oil, and water service

Fig. 1910, Type E is a reducing valve designed for initial pressures to 300 psi with gas, oil, water. The valve, of cast iron with bronze and steel trim, is of single diaphragm, single composition seat construction. It is claimed to have the largest capacity of any valve of its type and is available in six sizes, from ½ to 2 in. Its outlet or regulated pressure spring ranges are 5-35, 20-60, and 40-90. Features announced include simplicity of servicing, silent operation, piston-balanced for accurate regulation, and single seating for dead end service. Atlas Valve Co.

42—GREASE is formulated to resist gasoline

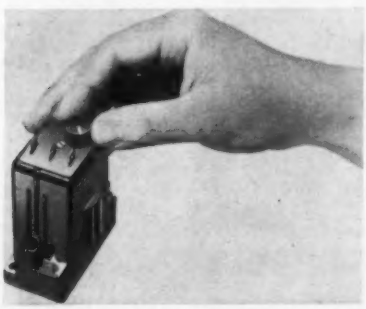
AMG5 Grease has a castor oil, non-soap base, says manufacturer, and the lubricating film is not affected by gasoline or any petroleum solvents. Its melting point is announced as above 400 F. Pacific Lubricants Co.

43—MOTOR OPERATOR for damper and valve control

This electronic transitorized motor operator for individual proportional applications is designed for damper and valve control in heating, ventilating and air conditioning systems. Compactness and simplicity are achieved through application of transistor components in its electronic circuitry. Electronic flexibility — choice among sensing elements, selection of compensated control, wide adjustment of range and ratio settings — is featured. Virtually self-contained, the attachment of a two-wire sensing element to a transistor operator forms a system of electronic control. Connection to a 115-v power source completes the installation. Data sheet F-8916 gives information. Barber-Colman Co.

44—TIME DELAY RELAY features transistorized control

Trans-O-Netic is a transistorized time-delay relay employing an electronic timing system to achieve fast switching action, instantaneous reset, high timing accuracy and full reproducibility of the time delay period even during rapid recycling. It uses a transistorized control circuit and an R-C network — the



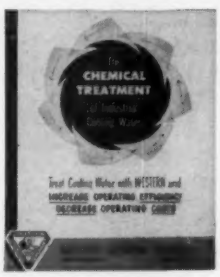
Write Western Today!

For these technical bulletins on

Water, Steam & Fuel Treatment

The Chemical Treatment of Boiler Feed Water. This technical bulletin contains a clear explanation of the causes of boiler water problems and Western's methods of solving them. Special emphasis on scale prevention, corrosion control, sludge dispersion, and suppression of foaming and carry-over.

Steam Plus CORAVOL Equals Protection From Corrosion. This technical bulletin tells how CORAVOL, the original amine process, gives complete protection from corrosion to your entire steam-condensate circuit. Clearly explains the theory of corrosion and the application of volatile amines to steam systems. Cites typical case histories of the use of CORAVOL in various plants and industries.



The Chemical Treatment of Industrial Cooling Water discusses common cooling water problems—scale, corrosion, algae, slime. Also presents Western's proven methods for controlling and preventing these conditions in cooling towers, evaporative condensers, process heat exchangers, engine and compressor jackets, chilled water systems, etc.

Better Fuel Performance and Economy discusses the causes and effects of sludge in fuel oil supplies and soot deposits in combustion areas. Shows how these troubles can be eliminated economically, dependably, and permanently with time-tested special Western formulas.

Also, Technical Bulletins on the chemical treatment of potable and plant water supply—refrigerating brine—sweet water systems. Also, the use of Dry Acid Scale Removers.

WESTERN CHEMICAL COMPANY — PIONEERS IN CHEMICAL WATER

Whatever your water, steam or fuel treatment problem may be, you can rely on special Western formulas and individual technical service to solve it dependably and economically.

WESTERN CHEMICAL COMPANY

717 Washington Street Kansas City 5, Missouri

For more data circle 562 on Post Card

Which of these characteristics are essentials on your Remote Control Jobs?

• Accuracy . . . High Load Capacity . . . Adaptability . . . Freedom from Trouble . . . Long Life . . . Flexibility . . . these are some of the qualities of ACCO TRU-LAY PUSH-PULL *flexible* CONTROLS that have made it possible to improve the operation of literally hundreds of mechanical products (list on request). Full description of this versatile REMOTE CONTROL is given in our DATA FILE available for your further study.

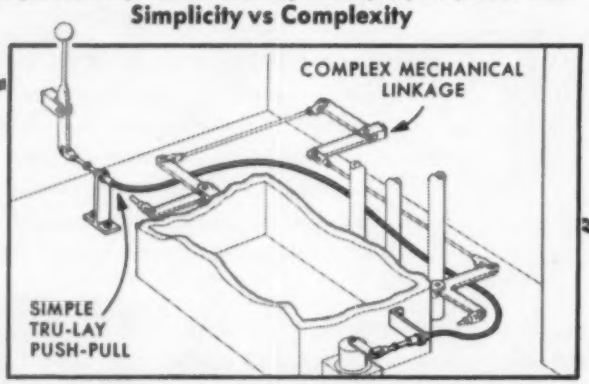
ACCURACY is inherent in the basic design, and in the standards of quality and precise dimension that control the manufacture of TRU-LAY PUSH-PULL CONTROLS. These are precision products, not gadgets.

VERSATILITY of this fine remote control can best be illustrated by citing some of the jobs it handles well . . . HOT jobs on jets and industrial furnaces . . . COLD jobs down to —70°F . . . WET jobs (the conduit can be completely immersed) . . . DIRTY jobs . . . ABRASIVE jobs . . . CORROSIVE jobs . . . HEAVY, TOUGH jobs up to 1,000 lbs. input . . . LIGHT DUTY jobs . . . REMOTE jobs 150 feet or more from the control point. These units are frequently and successfully used in conjunction with electric, hydraulic and air controls . . . are thoroughly effective under almost any operating condition.

"Solid as a rod but *flexible* as a wire rope" aptly describes TRU-LAY PUSH-PULL CONTROLS. This flexibility provides positive, remote action whether anchorages are fixed or movable . . . it damps out noise and vibration . . . protects delicate instruments . . . it permits ease of handling and shipping even when assemblies are 100 or 150 feet long . . . it avoids the risk of damage always present with solid tubular controls that must be preformed to position . . . and flexibility greatly simplifies installation of controls by reducing the number of working parts and by making it possible to snake around obstructions.

Advantages of Tru-Lay Push-Pull flexibility and simplicity are pictured below

Simplicity vs Complexity



Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased back-lash, lost accuracy and vibration rattles.

• Whether your interest is in a single application of this versatile PUSH-PULL CONTROL, or in its inclusion as a component of the product you manufacture, the six booklets and bulletins in this DATA FILE will answer your further questions, and will also provide you with the means of defining to us the applications you may be interested in.

Write for a copy without obligation

ACCO

AUTOMOTIVE and AIRCRAFT DIVISION
AMERICAN CHAIN & CABLE

Push-Pull DATA FILE

601-M Stephenson Bldg., Detroit 2
6800-M East Acco Street, Los Angeles 22 • 929-M Connecticut Ave., Bridgeport 2, Conn.

For more data circle 563 on Post Card

latter serving only as a time pilot for the control circuit which, in turn, operates a high-speed electro-mechanical switching unit. Quantity lots of the Trans-O-Netic are claimed accurate to within ± 10 per cent of the specified time delay, and temperature effects negligible over operating range of zero to 130 F. The relay is available with either fixed or adjustable time delay periods of 1.5 to 30 sec. Bulletin 5300 gives data. Heinemann Electric Co.

175—DRYER-RECEIVER supplies cleaned compressed air

This single unit is a compressed air receiver tank with built-in dryer. Its double purpose is to purify and dry air to zero-dewpoint quality, and then to store and deliver the air clean and free of moisture to overcome fouling, corroding and freezing of instruments, air tools, controls, chemicals etc. Manufacturer says the process can be operated from large centralized "plant size" air station or small scattered units. The compact, single-vessel design is claimed to require minimum space, installation and maintenance. It operates without heat, regeneration or regulation, company notes, and with no volume loss and less than 1 per cent pressure drop. Capacities range to 8000 scfm and 6000 psig. Bulletin D-R gives details. Van Products Co.

176—INDUCED DRAFT FAN with improved air cooling system

Significant fuel savings and lower stack maintenance costs are said to result when boilers are equipped with these induced draft fans. Featuring a radiant heat cover between bearing and fan housing, the fan is designed to maintain a constant, controlled over-fire draft, thereby increasing fuel combustion efficiency and eliminating need for large stacks. Capable of handling combustion gases up to 800 F, the fan is of welded mild steel integral construction to prevent distortion at high temperatures. The radiant heat cover, together with an aluminum heat flinger device, serves to prevent excessive heat radiation and permit use of standard pillow block bearings. Stub stacks can be installed directly on the fan without additional supports, it is said. Lenigh Fan and Blower Div., Fuller Co.

177—PIPE HANGER RING for variety of applications

This adjustable pipe hanger ring provides a single unit which can be used in many applications. It consists of a metal band and a locking insert for attachment to a threaded hanger rod. The insert is self-locking through spring action as well as through the weight of the pipe supported. The ring is available in zinc or copper plate as standard, for pipe sizes from ½ through 3½ in. The band may be reshaped on the job if conditions require it. The wide band is said to make the ring well suited to installation of plastic pipe. Automatic Sprinkler Corp. of America.

OXI CRYSTALS

"Open Sesame" to clean boilers and furnaces! ...more heat with less coal!

If you burn coal *OXI Crystals will increase boiler efficiency* by getting rid of slag, firescale, encrusted carbon and soot *fast* . . . all combustible deposits are completely oxidized from firedoor to the top of the stack . . . all this with very little labor involved.

By adding OXI Crystals you get more heat and steam with less coal. Superheater and economizer efficiencies increased. Stack temperatures are reduced. Cleaning costs are greatly reduced.

Ask for more information about this amazing product today.

Also ask about KOR, *the perfect fuel oil conditioner* . . . and SURFBLOW, *the floating, boiler water skimmer.*

OXI CORPORATION
82 — BOX 485
GARY, INDIANA

For more data circle 564 on Post Card

Shown above is 3000-cfm VAN-AIR Dryer—the type used by steel, automotive, chemical, container and other plants. Installed in compressor room it purifies and delivers clean, dry air to plant-wide operations. Many other capacities (see below) are also available in the complete line of VAN-AIR

COMPRESSED AIR DRYERS

THAT OPERATE FOR LESS THAN 1-CENT PER [illegible] CU.FT.

The VAN-AIR Dryer is automatic. It purifies raw compressed air through a triple-action desiccator that extracts water and dirt—then reduces moisture to zero-dewpoint. It entails no heat, regeneration, volume loss or carry-over —under 1½ pressure drop. The clean, dry, "instrument" quality of Van-treated air is indispensable for air controls, tools, processes, etc. as a guard against corrosion, pollution, dilution, freezing, etc.

23 STANDARD CAPACITIES— 25 to 3000 cfm 30 to 6000 psi

PATS. PEND.

PLANT ENGINEERS! With an eye to efficiency (cost saving, too) look into advantages of dry compressed air. Ask for brochure with dewpoint graphs.

Van Air DRYER

VAN PRODUCTS CO. ★ Engineers ★ Manufacturers

5777 SWANVILLE ROAD, ERIE, PENNSYLVANIA

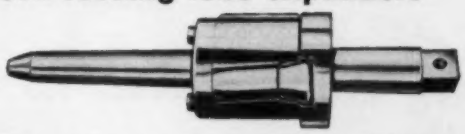
For more data circle 565 on Post Card

Keep boilers on the line with WILSON Maintenance Tools

Heavy-duty air driven tube cleaners

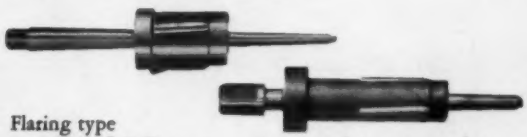
Designed to deliver maximum power at the most efficient cutter head speeds while negotiating sharp bends, the Model ECT Air Cleaners are excellent for cleaning curved boiler tubes from 2½" to 4½" O.D.

Self-feeding tube expanders



Wilson Model 38 tube expanders are self-feeding and parallel expanding. They are of the single flare roll type. Available for tubes 1" O.D. to 4½" O.D. with various roll lengths for tube seats ¾" and up.

Model E Expanders



Flaring type expander 1" O.D. to 4½" O.D. tubes, ½" to 2" tube seats

Long reach type expander 1" O.D. to 4½" O.D. tubes, 2½" to 5" tube seats

Right angle bevel gear drive

This Wilson bevel gear drive is expressly manufactured to meet continuous and heavy duty service conditions. The one piece all steel body is extremely rigid and not subject to distortion. The maintenance of perfect gear alignment is assured with consequent long service life.

Write today for your copies of Wilson Tube Cleaner catalog No. 77 and Wilson Tube Expander catalog No. 88.

Representatives in principal cities
Thomas C. Wilson, Inc. • 21-11 44th Ave., Long Island City 1, N. Y.
Cable address: "Tubeclean", New York

WILSON TW870

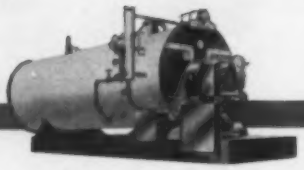
TUBE CLEANERS • TUBE EXPANDERS

For more data circle 566 on Post Card

WHICH TYPE OF PACKAGED BOILER is best for your installation?

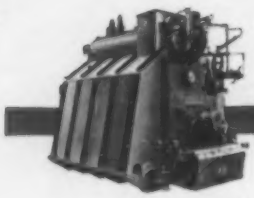
TYPE "C"

Horizontal four-pass fire tube packaged boiler for installations where space is limited. Capacities from 20 to 350 bhp. Fully automatic, burning oil, gas or both. Equipped with dependable Superior Rotary Burners and induced draft. Pressures to 250 psi. or for hot water operation. Write for Bulletin 1006C.



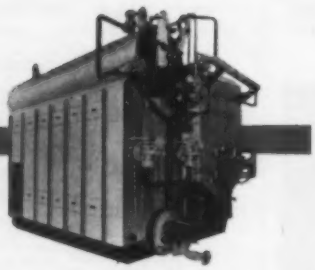
TYPE "F"

Horizontal four-pass fire tube Type "F" units are fully automatic, burning oil, gas or both. Capacities from 20 to 600 bhp. Pressures to 250 psi. or for hot water. Built-in induced draft for clean, quiet operation. Write for Bulletin 1006F.



TYPE "AS"

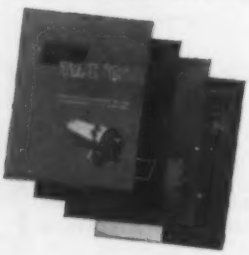
Completely packaged water tube boilers for steam capacities as low as 4000 lbs. of steam per hr. Fully automatic, burning oil or gas or both. Design pressure 190 psig. Rear-mounted mechanical draft fan, air-cooled furnace floor and firing front. Maximum capacity 13,000 lbs. of steam per hr. Write for Bulletin 1006S.



TYPE "D"

Completely packaged water tube boilers for capacities from 8,000 to 60,000 lbs. of steam per hr. Wide selection of burner and control arrangements. High, rear-mounted mechanical draft fan for quiet operation; uncluttered firing front. Write for Bulletin 1006D.

YOU'LL GET AN UNBIASED ANSWER FROM: SUPERIOR



Make your selection from the line that includes so many different models for capacities as low as 20 bhp., and as high as 60,000 lbs. of steam per hour. Water-Tube units, Fire-Tube units. Units that burn light oil, heavy oil, and gas.

Only Superior Combustion Industries makes them all as complete packages giving you and your consulting engineer freedom to choose a unit which closely meets the requirements of your installation.

THE WORLD'S MOST COMPLETE LINE OF FULLY PACKAGED BOILERS...

Specialists in PACKAGED BOILERS... exclusively

SUPERIOR PACKAGED BOILERS

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

For more data circle 567 on Post Card

CATALOG LIBRARY

Standard catalogs listed monthly to help you maintain a reference library. To order, use the post card at right.

COAL AND ASH HANDLING

201 Spreader Stoker — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash-removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lbs of steam per hour. Detroit Stoker Co.

202 Why Stainless-Clad Steel — Advantages of stainless-clad steel for coal handling equipment are detailed in this 16-pp bulletin. Photo-stories of typical applications in hoppers, chutes, bunker noses, pipes and spreaders are included. Lukens Steel Co.

203 Shredders, Crushers — Bulletin 257 describes and illustrates hammermills and shredders, rolling ring and special crushers for reducing chemicals, minerals, ceramics, and other materials including wood waste. Discusses construction features of the line and includes dimensions. American Pulverizer Co.

204 Car Shaker — Bulletin 60D describes the Riverside-Webster car shaker with "floating motor" designed for economical unloading of Hi-Hopper cars. Details design features and performance advantages of the shaker; provides specifications. Webster Mfg., Inc.

205 Hydraulic Shakeout — Bulletin 658 describes and illustrates the Carquake, hydraulically powered car shakeout designed for maximum car shaking with minimum noise. Rail- and stationary-mounted types are shown. Six advantages of the equipment are detailed. Stephens-Adamson Mfg. Co.

FUEL BURNING EQUIPMENT

206 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

207 Oil and Gas Burners — This illustrated bulletin presents oil and gas burners designed for shop assembled water tube boilers with automatic combustion and safety controls but applicable to other types. Single- and two-burner arrangements, as applied to company's A type boilers, are pictured. Wickes Boiler Co.

BOILERS, GENERATORS

208 Fire Tube Boilers — This 12-pp catalog describes Superior Compact pack-

FIRST CLASS
PERMIT No. 11
Sec. 34.9 P.L.&R.
BARRINGTON, ILL.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed in the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING
200 East James St.
BARRINGTON, ILLINOIS

FEBRUARY, 1959

NOTE: Card void after May 31, 1959

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

Name..... Title.....

Company Name.....
(Mail to included)

Company Address.....

City..... State.....
(If you prefer delivery at home, give home address, too)

Home Address.....

City..... State.....

Helpful Bulletins

101	102	103	104	105	106	107	
108	109	110	111	112	113	114	
115	116	117	118	119	120	121	
122	123	124	125	126	127	128	
129	130	131	132	133	134	135	
136	137	138	139	140	141	142	
143	144	145	146	147	148	149	
150	151	152	153	154	155	156	
157	158	159	160	161	162	163	
164	165	166	167	168	169	170	
171	172	173	174	175	176	177	

Equipment

1	2	3	4								
5	6	7	8								
9	10	11	12								
13	14	15	16								
17	18	19	20								
21	22	23	24								
25	26	27	28								
29	30	31	32								
33	34	35	36								
37	38	39	40								
41	42	43	44								

Catalog Library

201	202	203	204	205	206	207	208	209	210	211	
212	213	214	215	216	217	218	219	220	221	222	
223	224	225	226	227	228	229	230	231	232	233	
234	235	236	237	238	239	240	241	242	243	244	
245	246	247	248	249	250	251	252	253	254	255	
256	257	258	259	260	261	262	263	264	265	266	
267	268	269	270	271	272	273	274	275	276	277	
278	279	280	281	282	283	284	285	286	287	288	
289	290	291	292	293	294	295	296	297	298	299	

Advertised Products and Services

501	502	503	504	505	506	507	508	509	510	511	
512	513	514	515	516	517	518	519	520	521		
522	523	524	525	526	527	528	529	530	531	532	
533	534	535	536	537	538	539	540	541	542	543	
544	545	546	547	548	549	550	551	552	553	554	
555	556	557	558	559	560	561	562	563	564		
565	566	567	568	569	570	571	572	573	574		
575	576	577	578	579	580	581	582	583	584		
585	586	587	588	589	590	591	592	593	594		
595	596	597	598	599	600	601	602	603	604	605	

Use this space to ask for free sheets and other information.

aged boilers in capacities from 20 to 200 bhp. Interesting arrangement of text, illustration and color is used to explain many features of the units. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

209 Package Boilers — This 12-pp booklet on package steam generators describes the formulas behind all package steam generators, and illustrates how installation of a package steam generator can raise steam capacity in an existing boiler room. Cyclotherm Div., National-U. S. Radiator Corp.

210 Boilers for Many Services — This general product data catalog contains detailed literature on the company's line of boilers for heating, power and process steam. It contains separate data sheets for each product, including high pressure and low pressure boilers, boiler-burner units and water heating equipment. In addition to photos and diagrams illustrating design and operation features, it provides tabular engineering data. Industrial Div., American-Standard.

211 Self-Contained Boilers — Bulletin AD-162, 8 pp, describes company's complete line of self-contained boilers for heating and processing steam or hot water. Design features and advantages are detailed and a cutaway view showing flow of air in the forced draft system is included. Cleaver-Brooks Co.

212 Integral-Furnace Unit — Bulletin G-94 describes the Type PFI integral-furnace boiler, a pressurized-furnace oil-fired steam generator for power, process and heating loads requiring steam capacities to 400,000 lb-hr. at pressures to 1150 psi and temperatures to 900 F. Includes information on membrane wall, integral combustion air duct and preassembled boiler components. The Babcock & Wilcox Co.

213 For Low-Pressure Heating — Guide Specifications GS-1, 58 pp, covers underfeed stoker applications to boilers best suited to commercial and industrial heating plants. Includes drawings of flexible layouts of the equipment, as well as specification criteria covering coal and ash handling, boilers, stokers and controls. Bituminous Coal Institute.

TUBING AND ACCESSORIES

215 Heat Exchanger Tubing — Cited in 30-pp Catalog A-205 are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions, as to pollution, excessive turbulence, temperature and the like, required such tubing. The International Nickel Co., Inc.

216 Life Extension for Condenser Tubes — The 32-pp current edition of this booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in others. Revere Copper and Brass, Inc.

217 Tubes and Plates — Publication B-2, 46 pp, covers the subject of tubes and

FEBRUARY, 1956

NOTE: Card void after May 31, 1956

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

Name.....Title.....

Company Name.....
(Must be included)

Company Address.....

City.....State.....
(If you prefer delivery at home, give home address, too)

Home Address.....

City.....State.....

Helpful Bulletins

101	102	103	104	105	106	107
108	109	110	111	112	113	114
115	116	117	118	119	120	121
122	123	124	125	126	127	128
129	130	131	132	133	134	135
136	137	138	139	140	141	142
143	144	145	146	147	148	149
150	151	152	153	154	155	156
157	158	159	160	161	162	163
164	165	166	167	168	169	170
171	172	173	174	175	176	177

Catalog Library

201	202	203	204	205	206	207	208	209	210	211
212	213	214	215	216	217	218	219	220	221	222
223	224	225	226	227	228	229	230	231	232	233
234	235	236	237	238	239	240	241	242	243	244
245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266
267	268	269	270	271	272	273	274	275	276	277
278	279	280	281	282	283	284	285	286	287	288
289	290	291	292	293	294	295	296	297	298	299

Equipment

1	2	3	4	
5	6	7	8	
9	10	11	12	
13	14	15	16	
17	18	19	20	
21	22	23	24	
25	26	27	28	
29	30	31	32	
33	34	35	36	
37	38	39	40	
41	42	43	44	

Advertised Products and Services

501	502	503	504	505	506	507	508	509	510	511
512	513	514	515	516	517	518	519	520	521	522
523	524	525	526	527	528	529	530	531	532	533
534	535	536	537	538	539	540	541	542	543	544
545	546	547	548	549	550	551	552	553	554	555
556	557	558	559	560	561	562	563	564	565	566
567	568	569	570	571	572	573	574	575	576	577
578	579	580	581	582	583	584	585	586	587	588
589	590	591	592	593	594	595	596	597	598	599
600	601	602	603	604	605					

Use this space to ask for more data and other information.

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING

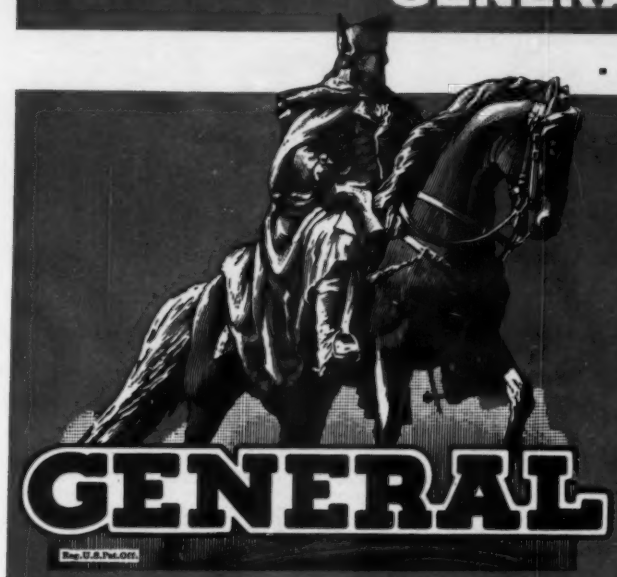
308 East James St.

BARRINGTON, ILLINOIS

FIRST CLASS
PERMIT No. 11
BARRINGTON, ILL.

GENERAL

. . . a trusted name in coal



For many decades, General Coal and its Associated Companies have successfully met the varied needs of all types of coal consumers. You can rely on this experience for all your coal requirements.

WESTMORELAND COAL COMPANY

HAMPTON COAL

STONEGA COKE & COAL COMPANY

GLENBROOK · STONEGA · RODA

DENDRON · CROSSBROOK

JEDDO-HIGHLAND COAL COMPANY

Hazle Brook Premium Anthracite

GENCO ANTHRACITE & BITUMINOUS COALS

General Coal Company

123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

Branches:

Buffalo · Charlotte, N.C. · Cincinnati · Cleveland · Irwin, Pa. · New York · Norfolk

For more data circle 568 on Post Card

DEOXY-SOL

SOLUTION OF HYDRAZINE

- Oxygen-
- Scavenger
- for
- Boiler Water
- Treatment

FAIRMOUNT CHEMICAL CO., INC.

136 Liberty St., New York 6, N.Y.

Midwestern Representative:

J. H. Delamar & Son, Inc.
4529 No. Kedzie Avenue
Chicago 25, Ill.

Ask for pamphlet BW

For more data circle 569 on Post Card

ANOTHER Large State University, the UNIVERSITY of MISSOURI, has included two large LACLEDE CHAIN GRATE STOKERS in its Expansion Program

One of two identical Laclede Chain Grate Stokers at University of Missouri Power Plant

LACLEDE STOKER COMPANY

4440 HUNT AVE.
ST. LOUIS 10, MO.

FOUNDED IN 1904

Each 266 sq. ft. stoker-fired steam generator is designed to produce 75,000 PPH continuously with peaks of 82,500 PPH.

An efficiency test using the input-output method which accounts for all losses, was conducted by Burns and Roe, Inc., Consulting Engineers of New York City. See how the test results exceeded the guarantees.

	GUARANTEE	TEST RESULTS
CO_2 leaving economizer	13.7%	13.7%
Combustible loss	1.2%	0.9%
Overall efficiency	83.0%	86.3%

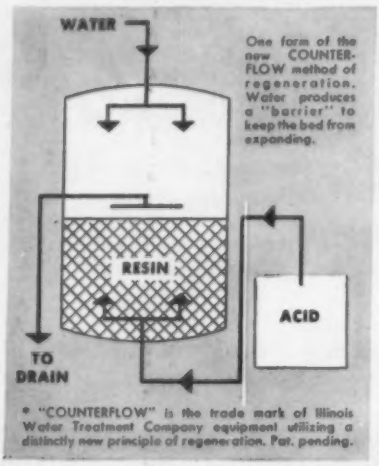
For most efficient, economical operation use Laclede Chain Grate Stokers.

For more data circle 570 on Post Card

ILLCO-WAY
ionXchange

COUNTERFLOW*

REGENERATION OF ION-EXCHANGERS



One form of the new COUNTERFLOW method of regeneration. Water produces a "barrier" to keep the bed from expanding.

* "COUNTERFLOW" is the trade mark of Illinois Water Treatment Company equipment utilizing a distinctly new principle of regeneration. Pat. pending.

"COUNTERFLOW" is a method whereby upward regeneration, which has long been recognized as most desirable, is successfully accomplished by establishing a "barrier" at the resin face.

LOOK AT THESE RESULTS!

- De-ionizer in a power plant. Conductivity of effluent improved from 10 micromhos to 4 micromhos after conversion to COUNTERFLOW. Cation leakage, expected at 4 ppm with downflow regeneration, actually is only 1 ppm.
- Chemical company in Middle West, 480 ppm TDS in raw water. Expected cation leakage with conventional regeneration, 9 ppm; with COUNTERFLOW, only 1.2 ppm.
- Distillery in Middle West. TDS in raw water, 575 ppm. Expected cation leakage with conventional equipment, 6 ppm; with COUNTERFLOW, is actually only 1.5 ppm.
- Western power plant, converted to COUNTERFLOW. Savings in acid reduction, $16,000.00 per year. TDS in raw water, 342 ppm. Predicted cation leakage from curves for conventional design equipment, 4 ppm; with COUNTERFLOW, actually only 1.6 ppm.

ILLCO-WAY

ILLINOIS WATER TREATMENT CO.
840 Cedar St.
Rockford, Ill.

NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

For more data circle 571 on Post Card

plates for condensers and heat exchangers. Fields of application and particular problems encountered in each are described. Information on condenser tube alloys, plates for tube sheets and baffles, manufacturing methods, installation, operational factors affecting tube life, corrosion factors in condenser tube service is presented. A section of physical properties and data included. The American Brass Co.

218 Tube Expanders — Catalog 88, 119 pp, is full of detailed information about tube expanders and associated tools used for tube rolling. Profusely illustrated, catalog provides information relative to boilers, condensers, evaporators or miscellaneous heat exchangers. Special sections are devoted to expanders, accessories, measuring instruments, rollers, extensions and drives. Each type of equipment is described, application and engineering data included. Thomas C. Wilson, Inc.

219 Tube Expansion Control — Bulletin 64 describes a tube expansion control which automatically controls expansion by accurate measurement of torque. Advantages are detailed and specification data furnished. Airetool Mfg. Co.

220 Tube Cleaners — Bulletin G-515 describes company's line of air, steam and water driven tube cleaners and accessories. Photos of the various types of cleaners are included, along with descriptive details and specification data. Elliott Co. — Roto Plant, Div., Carrier Corp.

INSULATIONS

221 Pipe Insulation — This 40-pp catalog was designed as a reference guide to company's pipe insulation, presenting a new way to specify proper thickness for pipe insulation, based in the "J" factor. This special index eliminates complicated computation formerly required to determine economical thicknesses. The book also features detailed drawings that show how single-layer insulation is applied to various vertical and horizontal expansion joints as well as to pipe bends, flanges, fittings. Union Asbestos & Rubber Co.

222 Thermal Insulation — Advantages of company's heat and sound insulation made of incombustible, moisture resistant mineral fibers with a small amount of thermosetting resin binder are detailed in this product bulletin. Heat resistance and sound absorption data are tabulated, as well as sizes and densities and other information. Baldwin-Hill Co.

WATER CONDITIONING

224 Handbook on Demineralizing — Comprehensive 40-pp Bulletin 5800 compares various methods of water treatment, indicating the comparison between demineralizers and evaporators. It discusses the characteristics of the various types of available cation and anion exchange materials and offers data on operating costs of demineralizing. It tells when to use two-bed, three-bed, four-bed, mixed or mono-bed demineralizers. It also indicates when decarbonators or vacuum deaerators should be installed. Cochrane Corp.

225 Evaluating Steam Purity — Technical Paper 135, entitled "Conductivity vs Sodium by Flame Spectrophotometry In Steam-Purity Studies," discusses results of laboratory and plant work to indicate that sodium is extremely valuable in evaluating steam purity. Performance curves are included in the paper. Betz Laboratories, Inc.

226 Boiler Water Treatment — Chemical reduction of oxygen in boiler feedwater with hydrazine is the subject of 10-pp Bulletin BW. Economy and operation, handling of the Deoxy-Sol, methods of analysis and other details are covered. A bibliography lists supplementary reading. Fairmont Chemical Co., Inc.

227 For Water Treatment — Featured in this 8-pp Bulletin 4447 is a range of equipment for water treatment, including Aerators, degasifiers, deaerators, chemical feeders, precipitation equipment, filters, and ion exchange equipment. Also describes and illustrates gas analysis and control systems. The Permutit Co.

228 Corrosion Inhibitor — Bulletin 420-12-9 describes manufacturer's Composition TG, a sodium-zinc hexametaphosphate corrosion inhibitor for water systems, stressing its superiority in controlling corrosion in water mains and cooling equipment. Provides comparative graphs showing flow coefficients, rate of film formation as determined by weight loss and current flow, and schematic drawings of feeding methods. Calgon Co., Hagan Chemicals & Controls, Inc.

229 Water Treatments — Described in this bulletin are three protective water treatments available from the company. Gives detailed explanations of potable water treatment, sweet water treatment and others. Western Chemical Co.

230 Mixed-Bed De-Ionizers — Practical equipment for mixed-bed deionization of flow rates of 5 gph to 5000 gpm is described in this 8-pp bulletin. Advantages of construction and design are detailed, as well as mechanical features, installation. Illinois Water Treatment Co.

231 Cooling System Treatment — Bulletin C1 describes advantages of company's treatment for cooling tower systems with synergised polyphosphates. Details of the system are fully covered. National Aluminate Corp.

232 pH and Chlorine Control — The 13th, 1957 edition of company's handbook, "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrate, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium magnesium, silica, nitrate, hardness. Available to qualified power engineers, please state your job title. W. A. Taylor Co.

Postage-free cards for ordering catalogs are on page 124. You may also use the cards to order literature mentioned in the ads.

233 Feedwater Heaters — Open-Coil, tray-type feedwater heaters and purifiers of both deaerating and nondeaerating type are presented in 12-pp Bulletin 117-A. Construction and operational features of the heaters are explained and illustrated, and more than a dozen available models are pictured along with application sug-

gestions. They cover capacities from 3000 to 300,000 lb per hour. Stickle Steam Specialties Co.

PUMPS AND COMPRESSORS

235 Flow Control — Twelve-pp Catalog 801 describes four basic models of precision proportioning pumps for uses requiring accurate and positive proportioning of flow in range of 0 to 730 gph. Materials of construction, capacities and pressures are shown for each. Diaphragm valves are discussed and their features noted. A section on plastic valves and diaphragms features those for temperatures to 300 F, and includes diaphragm material chart. Hills-McCanna Co.

236 Low Pressure Compressors — Eight-pp Bulletin A-95 describes a line of low pressure compressors for heavy duty industrial applications. Engineering design features are detailed and advantages explained. Joy Mfg. Co.

PACKINGS, GASKETS, SEALS

237 Mechanical Packings — Catalog P-210C contains 40 pp of detailed information on company's line of mechanical packings and gasket materials. It contains illustrations, descriptions, complete service recommendations and specification charts. Raybestos-Manhattan, Inc.

238 Mechanical Packings — Service and technical details on chemically-inert Teflon packings are provided in 8-pp Bulletin P-325 covering company's Chemlon line. Presents 15 types of braided construction, rings, six types of molded construction, cup and cone rings, combination sets. Gives recommendations as to services, applications and temperatures, also information on pressures, dimensions, mechanical requirements. Crane Packing Co.

VALVES, TRAPS, AND PIPING

239 Industrial Valves — Condensed Catalog 105, 28 pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations, describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Edward Valves, Inc.

240 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics covered. Crane Co.

242 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

243 Water Hammer Control — Cause, effect and control of water hammer in piping systems is the subject of 8-pp Bulletin WH 851. Photos, drawings and curves supplement text, and tests data is presented to show efficiency of company's silent check valves in water hammer control. The Williams Gauge Co., Inc.

244 For Lightest Condensate Loads — Bulletin T1744 (58) describes

Williams-Hager *Silent* CHECK VALVES

Architect: Harrison & Abramovitz
Consulting Engineers: Jaros, Baum & Bolles
General Contractor: George A. Fuller Co.
Plumbing Contractor: Sauer, Inc.
Heating & Ventilating Contractor: Limbach Co.

Protection for New 16-Story PORTER BUILDING

No effort has been spared in making Pittsburgh's newest building, headquarters for H. K. Porter Company, Inc., truly modern in every respect. In line with this policy, piping and pumps are protected by Silent Check Valves. These operate instantly when flow reversal starts or when flow is zero. *Write for Bulletin 654*

THE WILLIAMS GAUGE CO., INC.
143 Stanwix Street • 2 Gateway Center • Pittsburgh 22, Pa.
Our 73rd Year — 1886-1959
For more data circle 572 on Post Card

ENCO BURNERS

FOR
OIL, GAS OR TAR

Steam or mechanical atomizing...1 to 1000 gallons per hour

Designed for operation with either gas, oil or both with natural or forced draft. They can be depended on for maximum combustion efficiency.

ENCO Interchangeable Oil-Burners can be changed instantly to operate by either steam or mechanical pressure atomizing over a wide capacity range.

ENCO Oil Atomizers are applied to various types of standard pulverized-coal and gas-burner units cold starting or for full load operation when coal or gas is not available, or when oil is the more economical fuel.

Send for Bulletin OB-53 describing ENCO Gas and Oil Burners, also complete Pumping and Heating Units.

THE ENGINEER COMPANY, 75 West Street, New York 6, N. Y.

For more data circle 573 on Post Card

company's No. 30 impulse steam trap for use where condensate must be handled in very small amounts. Lists advantages and applications, tells how trap works and gives capacities, dimensions, materials used, prices. Yarnall-Waring Co.

245 Steam Trap Book — Catalog K 48-pp is a manual of steam trapping practice. It includes a section giving physical data and prices on OF & T traps, cast semi steel and forged steel inverted bucket steam traps, compound traps, ball float air and air relief traps. A handbook section explains how to calculate condensate load, and select traps for all classes of equipment; a maintenance section explains trap installation, testing, and maintenance. Armstrong Machine Works.

246 Materials for Main Steam Piping — Entitled "The Plastic Ductility of Austentic Piping Containing Welded Joints At 1200 F," this 16-pp bulletin deals with an investigation into the problem of selection of materials for main steam piping. Gives stress rupture characteristics of type 316 and 347 stainless steel piping adjacent to welded joints. Pittsburgh Piping and Equipment Co.

248 Industrial Expansion Joints — Advantages of company's line of industrial expansion joints designed for rugged temperature and pressure extremes are detailed in this illustrated brochure. Typical applications are pictured. Solar Aircraft Co.

249 Ball Joints — How to solve piping flexibility problems with company's ball joints is explained in illustrated Bulletin 31. Thermal expansion and contraction principle is illustrated and described and typical examples given. Barco Mfg. Co.

LUBRICATION

251 Organized Lubrication — Benefits of organized lubrication are extolled in this 24-pp bulletin. Cost control opportunities are detailed and the task of assigning responsibilities and delegating authority in an organized lubrication system discussed. Method of determining savings and setting up records to measure results is also covered. The Texas Co.

252 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, uses, properties. Standard Oil Co. (Ind.)

INSTRUMENTS, CONTROLS

254 Instruments and Controls — Catalog 57-6 describes instruments and controls, including flow meters, liquid level or pressure gage, CO_2 meters, boiler meters, pneumatic transmitters, strip chart recorder, pressure, vacuum and differential recorders, temperature recorder, multipoint gages and others. Includes descriptive data. Republic Flow Meters Co.

255 Temperature Regulators — Ten-page Bulletin 620-2 describes features and advantages of company's line of temperature regulators consisting of a thermostat with capillary tubing and a valve. Includes information on typical applications, as well as dimensional data, diagrams, discharge pressure curves, and a valve selection chart. Sarco Co., Inc.

257 Metering, Control Systems — Bulletin 500 describes purpose, design and operation of company's metering and control systems. Includes discussion of pneumatic and electric telemetering and pneumatic control, along with detailed literature references, Bailey Meter Co.

258 Ring Balance Meters — Specification Sheet PM-10002 features a line of ring balance meters designed to convert fluid differential pressure measurements into flow records and indications. Includes description of operation, specifications. Hagan Chemicals & Controls, Inc.

259 Ideas on Push-Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

261 Level Alarms, Fuel Cut-Outs — Brochure D1 describes float operated low and high water level alarms and fuel cut-offs, for low and medium pressure boilers, tanks and other vessels. Reliance Gauge Column Co.

263 Enclosed Governor — Bulletin 504 describes a fully enclosed, self-lubricated governor designed to give precise engine speed control. A schematic diagram shows component parts. Troy Engine & Machine Co.

This Self-Contained Fluid Cooling System

... gives most accurate temperature control

Applied in cooling industrial machines or processes to temperatures approaching the ambient wet-bulb, the NIAGARA *Aero* HEAT EXCHANGER is independent of any more than a nominal water supply or disposal. The coolant system is a closed one, free from dirt and maintenance troubles.

Heat is removed from your process *at the rate of input,* giving you precisely the temperature you require and assuring the quality of your product. Heat may be added to prevent freezing in winter or for better control in a warm-up period. Liquids or gases are cooled with equal effectiveness.

Heat is rejected outdoors. Only the little water evaporated on the cooling coils in the air stream, or discharged to prevent hardness build-up, is consumed.

Niagara sectional construction saves you much installation and upkeep expense, gives full access to all interior parts and piping. Your equipment always gives you full capacity and "new plant" efficiency.

Write for Niagara Bulletin No. 132 for complete information

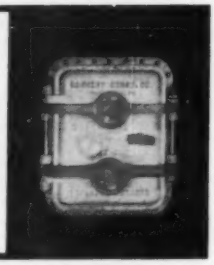
NIAGARA BLOWER COMPANY

Dept. E-1, 405 Lexington Ave., New York 17, N.Y.

District Engineers in Principal Cities of U. S. and Canada

For more data circle 574 on Post Card

HIGH PRESSURE CLEAN OUT DOORS



- Asbestos-Packed Cast Iron Construction
- Double Crossbar, Hinge and Handwheel Design
- Right or Left Hinge
- Available with Double Locking Device to prevent accidental locking from outside only
- Assures Maximum Strength, Efficiency and Economy for *every* High Pressure Application

IMMEDIATE DELIVERY IN SIZES FROM 15" x 18" to 24" x 36"

FROM $95.00 to $275.00 each

CONNERY
CONSTRUCTION COMPANY
STEEL PLATE CONSTRUCTION
2nd and Luzerne Sts.
P. O. Box 4437, Philadelphia 40, Pa.

For more data circle 575 on Post Card

ELECTRICAL EQUIPMENT

264 Selecting Protective Devices — The Protection Handbook, 24 pp, is based on the 1956 National Electrical Code, and interprets this code into easily read form. It covers the selection of protective devices for electric circuits, motors, appliances and apparatus, and includes a list showing the size to use when ordinary fuse, Fustron dual-element fuse or Fustat is installed. All information is condensed. Fully illustrated, book gives wiring diagrams, motor tables. Bussmann Mfg. Co.

265 Cable Troughs — This 28-pp catalog offers a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings, horizontal elbows, inside and outside vertical elbows, ties, crosses, covers and many special fastening devices to save time and labor. Contains full instructions for installations, load charts, accessory items. The Globe Co.

REFRIGERATION AND AIR CONDITIONING

266 Refrigeration Condensers — Engineering data on a complete range of sizes and types of refrigeration condensers are featured in 38-pp Bulletin RC-2. Ratings in tons refrigeration are tabulated for large and small ammonia condensers, vertical ammonia condensers, ammonia condenser-towers, freon condensers and freon condenser-towers. Selection data, dimensions, dimensional diagrams and tables of pipe sizes given. Henry Vogt Machine Co.

267 Air Conditioner — Advantages and applications of company's air conditioner, designed to give precise control of air temperature and moisture, are detailed in 8-pp Bulletin 122. A cutaway diagram shows component features. Niagara Blower Co.

OTHER EQUIPMENT

269 Steel Plate Construction — Pictured and described in this 20-pp bulletin are some of the steps in the fabrication of steel plate into boiler breechings, casings, duct work, stacks and special shapes, from initial design stage to final erection at plant site. The bulletin is generously illustrated with photos of typical plants utilizing these fabrications. They cover a wide range of industries, including paper, petroleum, steel, as well as utilities. Connery Construction Co.

271 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters, explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

272 Cooling Towers — Featured in 20-pp Catalog DFA-58 is company's double flow Aquatower, combining high efficiency with low silhouette. Specifications and engineering data are included, as well as dimensional drawings showing construction features. The Marley Co.

274 For Quiet Heating — Described in this bulletin is the HusHeater, designed to heat — without making a sound — water and liquids by introduction of steam into the liquid. Lists advantages of the HusHeater, explains how to install it and tells how to order. Most common application is in filter boxes and hotwells; other applications are in heating processes in sugar refineries, others. Sims Pump Valve Co. Inc.

276 Equipment Selector Charts — Bulletin CE-50, 20 pp, contains selector charts on corrosion-resistant equipment for process industries. Tables cover general considerations in selection of material, physical properties, corrosion resistance, techniques and skill in manufacture of equipment. Describes rubber and plastic pipe, tubing and fittings; valves; pumps; as well as lined tanks. Amerace Corp, American Hard Rubber Co.

278 Insulated Piping — Bulletin 57-1, 24 pp, on prefabricated insulated piping systems, shows typical uses for Hel-cor pipe units for underground or overhead pipe systems. Also describes Utilidor conduits for protection of underground utility services. Sample specifications and conduit sizing charts given. Ric-wiL, Inc.

279 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

280 Brine-Making Manual — Details on modern brine-making methods and equipment are presented in 12-pp Manual 135. Three types of brine-makers are described, as well as a wet salt storage system, and cutaway views and diagrams are included. Morton Salt Co.

Don't blow your salary down the sewer!

You may be wasting that much and more by intermittent blow-off, which is just a guessing game. It helps nobody but the fuel company. By contrast, you can now get a system of continuous blow-off that blows just enough all the time. Never forgets, never fails, pays its own cost in a matter of months. You owe it to yourself and the boss to find out about it; write for a copy of "Modern Blow-off" to *The Madden Corp., 1345 Jarvis Ave., Chicago 26, Illinois.*

For more data circle 576 on Post Card

Quiet

PERFORMANCE

with

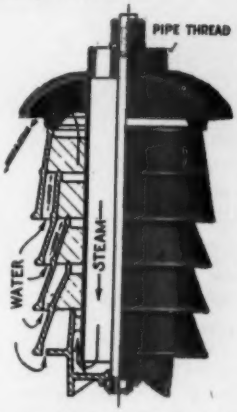
SIMS

HUSHEATERS

NO VIBRATION

Always in hot water but never complains!

Now you can inject Live Steam into liquids in processing plants, boiler feed hot wells or elsewhere without nerve-shattering noise and tank-wrecking vibration.



The Sims HusHeater:

• Conserves maximum heat in available steam. • Heats liquids efficiently. • Eliminates burning and discoloration of liquid in process. • Reduces burden on heater. • Reduces back-pressure on auxiliaries. • Increases temperature of feed water to the boilers. • Saves Steam.

Steam flows down thru the center tube, and up thru converging nozzles. The high velocity sucks the liquid in to mixing chamber along the hot center tube. No moving parts.

Sims PUMP VALVE CO., INC.

1314 Park Avenue Hoboken, N.J.

(N.J.) SWarthmore 2-0600 (N.Y.) BArclay 7-7661

CABLE: SIMSVALV HobokenNJ

For more data circle 577 on Post Card

ADVERTISERS' INDEX

Aerovent Fan Co., Inc. 132
Air Preheater Corp., Inc. 65
Airetool Mfg. Co., The ..... *
American Brass Co. 27
American Chain & Cable Co. Automotive & Aircraft Div. 120
American Engineering Co. ..... Cover II
American Gilsonite Co. 99
American Hard Rubber Company 115
American Pulverizer Co. 131
Anderson Co., V. D. ..... *
Armstrong Machine Works 7
Automotive & Aircraft Div. American Chain & Cable Co. 120

Babbitt Steam Specialty Co. 132
Babcock & Wilcox Co., The (Boiler Div.) 20-21
Babcock & Wilcox Co., The (Refractories Div.) ..... Cover III
Bailey Meter Company 23
Baldwin-Hill Co. 36
Baltimore & Ohio RR ..... *
Barco Manufacturing Co. ..... *
Betz Laboratories, Inc. 95
Biddle Co., James G. 116
Bigelow Company, The 32
Bird-Archer Co., The ..... *
Bituminous Coal Institute 12-13
Buffalo Forge Company ..... *
Bussmann Mfg. Co. 16-17
Byron Jackson Pumps, Inc. ..... *

Calgon Co. ..... *
Cambridge Instrument Co., Inc. ..... *
Chapman Valve Mfg. Co., The ..... *
Cleaver-Brooks Co. ..... *
Clyde Iron Works, Inc. ..... *
Cochrane Corporation ..... *
Combustion Engineering, Inc. 14-15
Connery Construction Corp. 128
Copes-Vulcan Div., Blaw-Knox Co. 40
Crane Co. 109
Crane Packing Co. ..... *
Curtiss-Wright Corp. ..... *
Cyclotherm Div. National-U.S. Radiator Corp. 117

Dearborn Chemical Co. ..... *
De Laval Steam Turbine Co. 64
Detroit Stoker Company ..... *
Diamond Power Specialty Corp. 10-11
Dodge Manufacturing Co. ..... *
du Pont de Nemours & Co., E. I. ..... *

Eastern Gas & Fuel Associates 24
Edison, Thomas A. ..... *
Edward Valves, Inc. 18-19
Elliott Co. ..... *
Ellison Draft Gage Co. ..... *
Engineer Co., The 127
Erie City Iron Works ..... *
Everlasting Valve Co. ..... *

Fairmount Chemical Co., Inc. 125
Felt Products Mfg. Co. ..... *
Fisher Governor Co. 62-63
Flexonics Corp. 41
Foster Wheeler Corp. ..... *
Fuller Co. 34

General Coal Co. 125
General Electric Co. ..... *
Globe Co., Products Div. 118
Goodall Rubber Co. ..... *
Graver Water Conditioning 2

Hagan Chemicals & Controls, Inc. 58
Hall Laboratories 37
Hills-McCanna Co. ..... *

Illinois Water Treatment Co. 126
International Nickel Co., The 55

Johnson-March Corp. ..... *
Jones and Laughlin Steel Corp. ..... *
Joy Mfg. Co. ..... *

Kaisers Engineers 51
E. Keeler Co. ..... *
Kewanee Boiler Division 52
Kirk & Blum Mfg. Co. ..... *
Koppers Co., Inc. 131

Laclede Stoker Co. 125
Ladish Co. ..... *
Leslie Co. 113
Lukens Steel Company 56

Madden Corp. 129
Manning, Maxwell & Moore, Inc. ..... *
Marley Co., The 53
Maryland Shipbuilding & Drydock Co. ..... *
Mead-Morrison Division, McKiernan-Terry Corp. 42
Milton Roy Co. 31
Moore & Co., Samuel ..... *
Morton Salt Co. 101
Mueller Electric Co. 132

Nagle Pumps, Inc. ..... *
National Airoil Burner Co., Inc. ..... *
National Aluminate Corporation 57
Neff & Fry Co. 131
Niagara Blower Company 128

Old Ben Coal Co. ..... *
OXI Corp. 121

Peabody Coal Co. 97
Permutit Co., The 60
Pittsburgh Piping & Equipment Co. 1
Powell Valves, Wm. 35
Pratt Co., Henry 106

Raybestos-Manhattan, Inc. 30
Refractory & Insulation Corp. ..... *
Reliance Gauge Column Company 114
Republic Flow Meters Co. 54
Research-Cottrell Inc. 102-103
Revere Copper & Brass Inc. 111
Ric-wil, Inc. ..... *
Riley Stoker Corporation 104-105
Rockwell Co., W. S. ..... *
Roto Div. of Elliott Co. 28

Sarco Company, Inc. 22
Sims Pump Valve Co. 129
Sinclair Refining Co. ..... *
Socony Mobil Oil Co., Inc. ..... *
Solar Aircraft Co. 39
Spence Engineering Co. ..... *
Standard Oil Co. (Indiana) 5
Stephens-Adamson Mfg. Co. 29
Stickle Steam Specialties Co. ..... *
Stone & Webster Engineering Co. 33
Superior Combustion Industries, Inc. 122

Taylor & Co., W. A. ..... *
The Terry Steam Turbine Co. ..... *
Texas Co., The ..... Cover IV
Troy Engine & Machine Co. ..... *

Union Asbestos & Rubber Co. 59
U. S. Electrical Motors ..... *
Universal Atlas Cement Co. 38

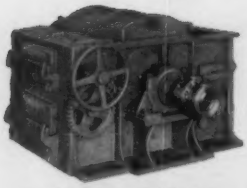
Valley Camp Coal Co., The 107
Van-Packer Co., Div. of the Flint-Kote Co. ..... *
Van Products Co. 121
Vogt Machine Co., Henry 61

Webster Mfg. Co. ..... *
Western Chemical Company 119
Wickes Boiler Co. ..... *
Williams Gauge Co. 127
Wilson, Inc., Thomas C. 121
Wolverine Tube Div. ..... *
Worthington Corporation ..... *
Wright-Austin Co. ..... *

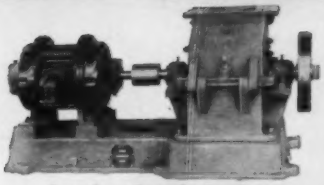
Yarnall-Waring Company 8-9, 66
Yuba Heat Transfer Div. ..... *

Firms whose advertising is not in this issue but is appearing in other issues are marked with an *

for dependable service...



American AC Series



American Sample Crusher

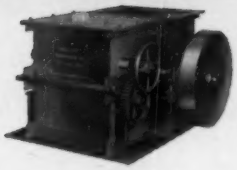
rely on coal crushers backed by American's 50 years of experience

Write for Literature On These Crushers

For large capacity
AMERICAN AC SERIES CRUSHER

For medium capacity
AMERICAN WC SERIES CRUSHER

For sample crushing
AMERICAN LABORATORY CRUSHER



American WC Series

American PULVERIZER COMPANY
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS
1246 MACKLIND AVE. SAINT LOUIS 10, MO.

For more data circle 578 on Post Card

NEW Metal Blade Aeromaster* Fan

AEROMASTER fans 54" to 22' for cooling towers and radiator-type coolers.

Lasts Longer • Costs Less

Efficiency . . . economy . . . durability—three important standards—are yours in the AEROMASTER fan.

AEROMASTER fans are efficient because they embody advanced aerodynamic principles. True airfoil blade sections give maximum air delivery.

AEROMASTER fans are economical because adjustable pitch angle of the blade permits a flexibility of setting which enables you to decrease fan load to an accurate minimum horse-power requirement. Design features reduce labor and installation costs.

AEROMASTER fans are durable because they are made from corrosion resisting, silicon-magnesium, aluminum alloys with high tensile strength, fine grain structure and increased endurance limit.

For more details write to KOPPERS COMPANY, INC., Aeromaster Fan Dept., 8202 Scott Street, Baltimore 3, Md.

*Koppers Trademark

KOPPERS

Aeromaster Fans

Engineered Products Sold with *Service*

For more data circle 579 on Post Card

X MARKS THE CRITICAL SPOTS!

It takes more than muscles to build a storage bin

Before the physical work of building a bin begins, we must know the problems involved at the *Three Critical Points.*

X What is the loading problem?

X What are the characteristics of the material to be stored . . . and its "flowability"?

X What is the volume and rate of discharge?

When planning your next storage bin, may we sit in on the very early stages of planning?

NEFF & FRY COMPANY
260 Elm St., Camden, Ohio

N&F

You can always spot a Neff & Fry Bin by the shape of the stave!

For more data circle 580 on Post Card

the downturn

and upturn at KVP

Same picture – different setting. Top shows complicated, space-wasting duct system which routed fumes back into plant for discharge through stacks. Bottom shows nine new 36" Aerovent "SP-7" Duct Fans installed to take fumes *up* and *out*, saving valuable floor space in busy working area. Just one of hundreds of successful Aerovent installations characterizing modern air engineering in action.

Write for free BULLETIN 400

All Aerovent Fans are rated in accordance with the Standard Test Code and U.S.D.C. Comm. Std. CS178-51.

Aerovent FANS

Aerovent
FAN COMPANY, INC.
ASH and BRUSH STS. • PIQUA, OHIO

Member Air-Moving and Conditioning Assn. (AMCA)

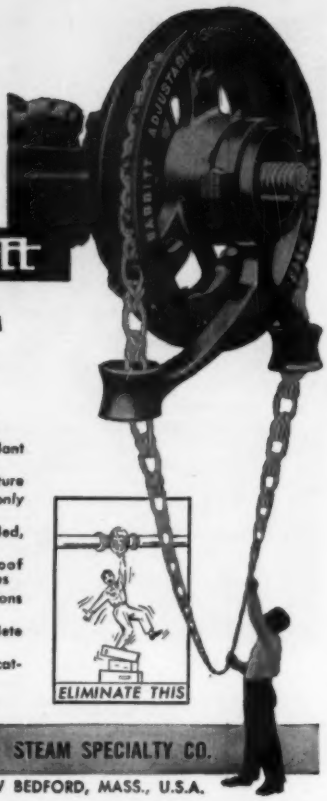
For more data circle 581 on Post Card

Safe Operation of Overhead Valves

with a

Babbitt

Adjustable
SPROCKET RIM
with Chain Guide



- Simplifies pipe layout
- Fits any size valve wheel
- Easy to install and operate
- Operates any valve from plant floor
- Time and money saving fixture
- No maintenance, first cost only cost
- Packed, completely assembled, one to a carton
- Hot galvanized, rust-proof chain available for all sizes
- Easy to follow instructions with each unit
- Your supplier carries complete stocks
- Write for new descriptive catalog sheet and prices

Babbitt STEAM SPECIALTY CO.

4 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

For more data circle 582 on Post Card

Send for FREE SAMPLE PACKET of the three new
MUELLER "70 SERIES" ALLIGATOR CLIPS
Low-cost, streamlined clips

with **SNAP!**

which is taking 1/2500th second to snap shut upon a wafer. Talk about acceleration!—the upper jaw hits 60 MPH in three-eighths of an inch. The upper jaw and flying wafer fragments have been caught in many images along their paths of movement.

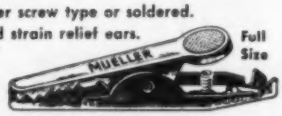
Photographed by means of a special process, it graphically illustrates the "snap" in Mueller's traditionally snappy springs. These springs provide a mean, corrosion-cutting bite for perfect test connections.

THE NEW "70 SERIES" ALLIGATORS FEATURE:

Simple, direct, streamlined design, and lower cost than the famous "60 Series".

Faster, easier connection, whether screw type or soldered.

A new patented hinge, and cord strain relief ears.



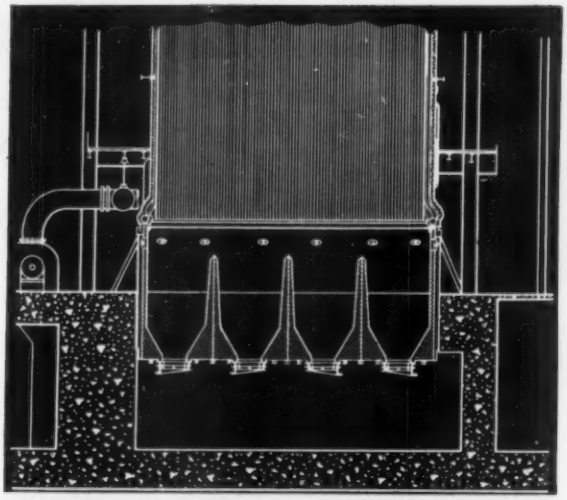
Full Size

WRITE FACTORY TODAY FOR FREE SAMPLE PACKET SHOWN ABOVE

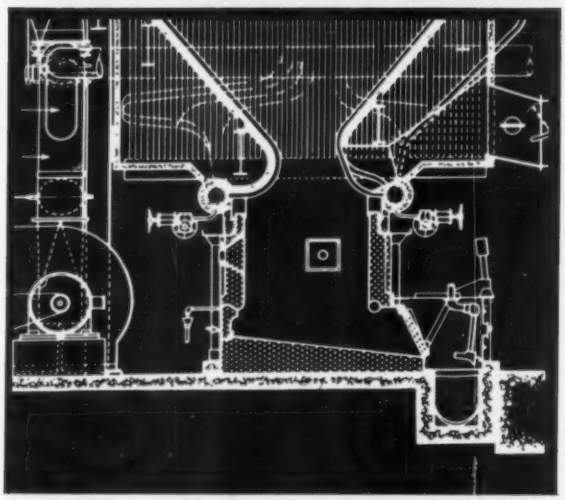
MUELLER ELECTRIC COMPANY

1568G East 31st Street CLEVELAND 14, OHIO

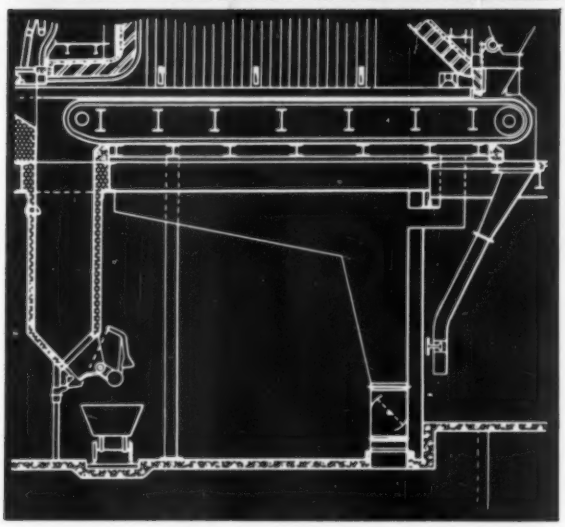
For more data circle 583 on Post Card



Erosion, due to dry ash sliding down the hopper, is the big problem in this ashpit.



Water jets can cause abrasion of ashpit floor refractories, and water splattered on the walls may cause spalling.



Continuous deposits of ash from a stoker-fired boiler have an abrasive effect on this ashpit lining.

Reduce refractory wear in ashpits with B&W Kaocrete

Relining ashpits is expensive. That's why power engineers specify heavy-duty B&W Kaocrete-D. On job after job, in all types of ashpits, this refractory castable has withstood the heavy abrasive and erosive attacks of sprays, jets, rakes and shovels.

The reason? Specially designed B&W Kaocrete-D has the strength and hardness needed for tough ashpit service. It has unusually high resistance to abrasion, erosion and spalling. It also saves time because it can be cast or gunned in place.

For the facts and figures on Kaocrete-D, as well as Kaocrete-A which is recommended for less severe applications, consult your local B&W Refractories Engineer.

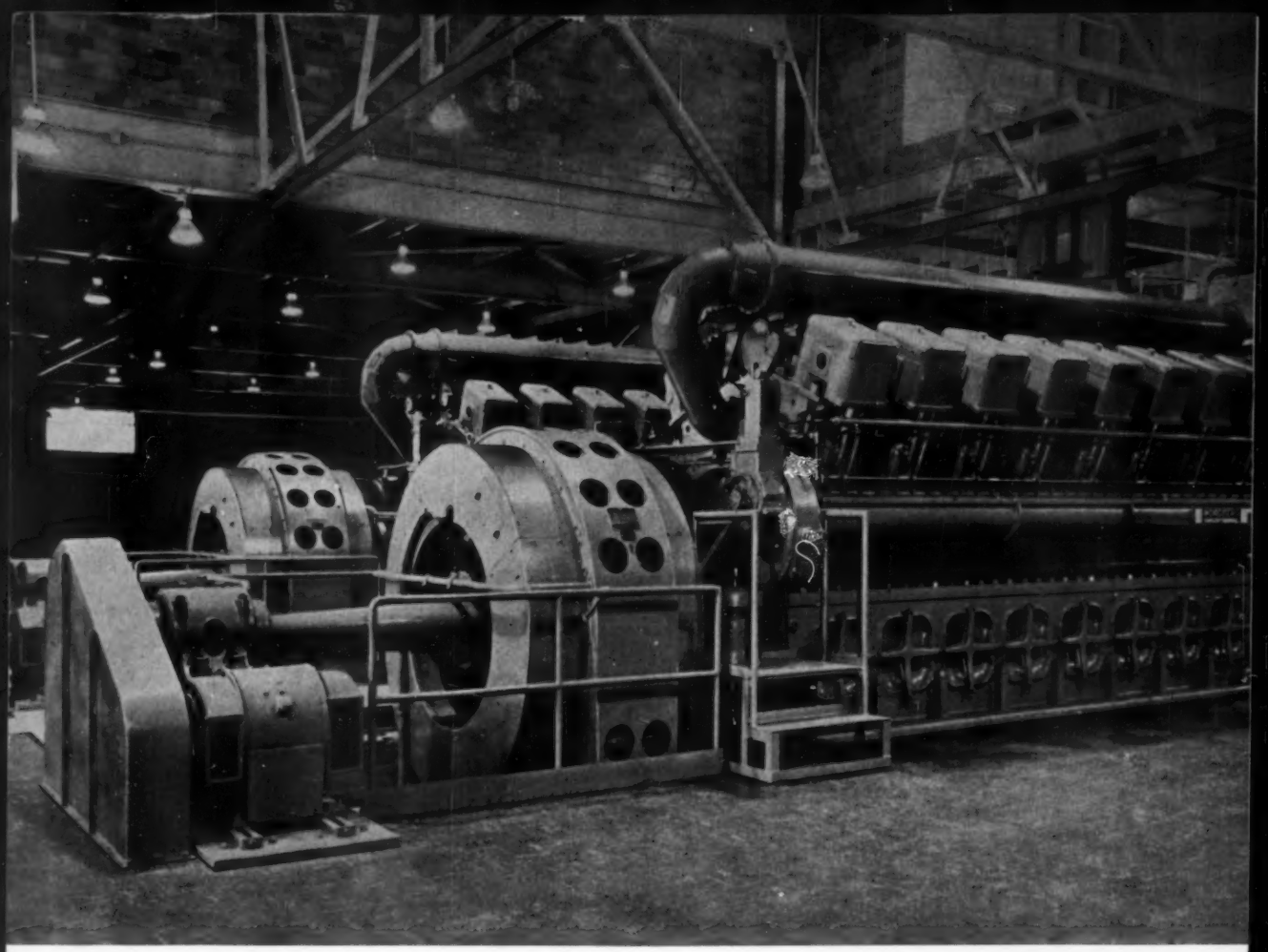
Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits.

R608

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide B&W Ramming Mixes • B&W Kaowool

BABCOCK & WILCOX
THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

For more data circle 584 on Post Card



Texaco Ursa Oil lubricates each of these V-type 16-cylinder diesels which supply standby power in Narragansett Electric Co.'s Westerly, R. I., plant.

Bore and stroke of each engine is 13 x 16½"; each is rated at 3,500 hp at 514 rpm. Each generator has a net rating of 2,500 kw.

Texaco Ursa Oil protects Narragansett's reserve power

Narragansett Electric Company uses these two Supairthermal V-16 diesels for standby power. It's essential that these engines be instantly available, even after long periods of idleness. That's why Narragansett uses Texaco Ursa Oil to protect engine power, keep it reliable and ready—anytime.

With Texaco Ursa Oil in the crankcases, Narragansett engineers are certain of getting full rated horsepower because Texaco Ursa Oil keeps rings free and prevents the formation of harmful deposits. And because Texaco Ursa Oil is a premium quality lubricant, it protects against wear, minimizes operating and maintenance costs.

There is a complete line of Texaco Ursa Oils refined and processed especially for the lubrication of diesel, gas and dual-fuel engines. In fact, *for over twenty-years, more stationary diesel horsepower in the United States has been lubricated with Texaco than with any other brand.*

Your Texaco Lubrication Engineer offers his years of experience to help you select the right Texaco lubricant for your needs. You can contact him by calling the nearest of the more than 2,000 Texaco Distributing Plants, or by writing: The Texas Company, 135 East 42nd Street, New York 17, N. Y.

Tune In . . . Metropolitan Opera Radio Broadcasts Every Saturday Afternoon.

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

For more data circle 585 on Post Card